

EXHIBIT A

Declaration of Lee Howard

**THE UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF MICHIGAN
SOUTHERN DIVISION**

MATTHEW N. FULTON, DDS, P.C.,
individually and as the representative of
a class of similarly-situated persons,

Plaintiff,

v.

ENCLARITY, INC., LEXISNEXIS
RISK SOLUTIONS INC.,
LEXISNEXIS RISK SOLUTIONS GA
INC., LEXISNEXIS RISK
SOLUTIONS FL INC., and JOHN
DOES 1-12,

Defendants.

Case No. 16-CV-13777

Chief District Judge Denise Page Hood
Magistrate Judge R. Steven Whalen

PUTATIVE CLASS ACTION

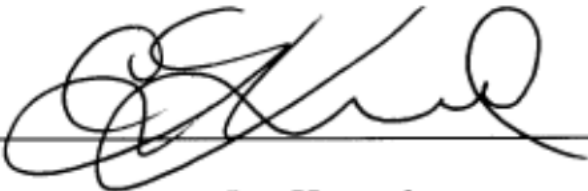
DECLARATION OF LEE HOWARD

1. My name is Christopher Lee Howard. I have been designated by Plaintiff in this matter as a witness it may use at trial to present expert testimony.
2. Attached as Exhibit 1 is a true and correct copy of my Expert Report dated September 29, 2021.
3. Attached as Exhibit 2 is a true and correct copy of my (Supplemental Rebuttal) Expert Report dated December 21, 2021.
4. My Expert Report and Supplemental Rebuttal Expert Report, together with the deposition testimony I have given in this matter, accurately and completely state my opinions, as well as the basis and reasons for same,

the facts or data considered by me in forming same, and the documents used to summarize and support same.

5. My Expert Report also includes a true and correct copy of my curriculum vitae summarizing my areas of expertise, knowledge, skill, experience, training and education.
6. I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed on 17 Jan 2022

A handwritten signature in black ink, appearing to read 'Lee Howard', is written over a horizontal line.

Lee Howard

Howard Declaration Ex. 1

Expert Report Dated September 29, 2021

REDACTED VERSION OF DOCUMENT
TO BE FILED UNDER SEAL PURSUANT TO LR 5.3(b)(3)(B)(iii)

**IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF MICHIGAN
SOUTHERN DIVISION**

MATTHEW N. FULTON, DDS, P.C.,)	
individually and on behalf of all others)	
similarly situated,)	
)	
Plaintiffs,)	Case No. 16-cv-13777
v.)	Hon. Denise Page Hood
)	
ENCLARITY, INC., LEXISNEXIS RISK)	
SOLUTIONS INC., LEXISNEXIS RISK)	
SOLUTIONS GA INC., LEXISNEXIS RISK)	
SOLUTIONS FL INC.,)	
)	
Defendants.)	
)	

Expert Report of Lee Howard

1. A complete statement of all opinions I will express and the basis and reasons for same, the facts or data considered by me in forming same, and the documents used to summarize and support same are as follows.

2. I am not a party to this matter.

3. I have acknowledged and agreed to be bound by the protective order as to confidentiality in this case.

4. I have worked since before 2001 as a fax consultant for many companies in deploying computer-based faxing services for their businesses. I am a developer of fax software. I have designed and developed fax software applications, as well as a software modem. I work full-time as the president and chief technology officer for a company that manufactures and sells hardware fax modems, provides an on-line fax service, develops associated fax software, and provides technical and consulting support to its customers for these associated products and services. I have been called upon as an expert witness in many other cases involving fax issues. Due to my experience and qualifications, I have been hired by plaintiff's counsel, Bock Hatch & Oppenheim, LLC, to consult with them and analyze fax communication data involved in this case. My CV is given on this report as Appendix A.

5. The following is a list of all publications authored by me in the previous 10 years:

<http://hylafax.sourceforge.net> (website)

<http://iaxmodem.sourceforge.net> (website)

<http://mainpine.com> (website, only portions are my work)

6. The following is a list of all other cases in which I have testified as an expert at trial or by deposition within the last four years:

- a. *Dr. Louis L. Sobol, M.D. v. Imprimis Pharmaceuticals, Inc.*, Case No. 2:16-cv-14339 (U.S.D.C. E.D. Mi.); deposited Jan. 19, 2018
- b. *KHS Corp. v. Singer Financial Corp., et al.*, Case No. 2:16-cv-00055 (U.S.D.C. E.D. Pa.); deposited Jan. 24, 2019
- c. *Brian Lyngaas D.D.S. v. Curaden AG, et al.*, Case No. 2:17-cv-10910 (U.S.D.C. E.D. Mi.), deposited Dec. 5, 2018 and June 13, 2019; trial testimony Sept. 18, 2019

7. Compensation for case examination, testimony preparation, and deposition testimony in this case will be at my usual and customary hourly rates as follows:

- a. \$400 per hour for expert report drafting and all testimony given in deposition and trial.
- b. \$225 per hour for data processing, including examination of provided data and computer programming for processing of data.

8. I reserve the right to amend or supplement this report as new information becomes available, or to further clarify the opinions expressed in this report in response to questioning at deposition or trial.

9. I was present at or have read and examined the following testimonies provided to me by plaintiff's counsel along with deposition exhibits which were:

Deposition of Matthew Fulton – June 11, 2021

Deposition of Jill Christ – August 23, 2021

Deposition of Alan Bergman – September 1, 2021

Deposition of Alex Szymanski – September 17, 2021

10. I have also read and examined the following which were provided to me by plaintiff's counsel:

- a. "Fax Services Agreement", (ENC_184 - Sfax Services Agreement (07-27-11).pdf.pdf) [sic]
- b. "Received Faxes", (Received Faxes.pdf), ENC_00000497, ENC_00000498, ENC_00000500, ENC_00000501, ENC_00001473 through ENC_00001483 sequentially, and ENC_00001489.
- c. "Phone Call Data", ENC_00001528 through ENC_00001530 sequentially.
- d. "Transmission Data", ENC_00001519 through ENC_00001527 sequentially.
- e. "Re: Fax Number Verification for Delivery of Patient PHI (Internal ID:34290748)", (Ex A subject fax-1.pdf) copy of fax to Dr. Matthew Norman Fulton, DDS.
- f. ENC_160 and ENC_00000504

11. Fax communication protocol employed by all fax machines, fax servers, and other fax devices is defined by an international standard known as “ITU-T T.30” or just “T.30” for short. This standard was developed, enhanced, and is supported by an organization known as the International Telecommunications Union, a specialized agency of the United Nations with headquarters in Geneva, Switzerland. As the procedure and signals defined by T.30 are highly relevant to my conclusions regarding this matter, a copy of the current revision of T.30 is provided as Appendix B.

12. T.30 utilizes many other documented ITU standards in its definitions including V.21, V.34, V.17, V.29, V.27ter, T.4, and T.6. T.30 is referenced by related fax standards such as T.37, T.38, T.31, and T.32. Analysis of the specifics defined by these other standards is not necessary to reach my conclusions in this matter.

13. T.30 signals transmitted from one fax station to another are converted from a digital message into an audio waveform through a process known as “modulation”. The modulated signal is communicated over the audio telephone connection by the first endpoint, and the other endpoint will convert the waveform back into a digital signal through a process known as “demodulation”.

14. Fax communication protocol as found in T.30 involves five general phases as follows:

Phase A: call establishment

Phase B: identification and parameters negotiation

Phase C: document communication

Phase D: message confirmation

Phase E: disconnection

15. During Phase B the fax terminal which receives the call (“receiver”) first transmits various identification and handshaking signals. Among these are signals known as “NSF” (non-standard facilities), “CSI” (called subscriber identification), and “DIS” (digital identification signal). NSF is a signal that the receiver may transmit to identify its manufacturer and a unique set of proprietary facilities given to it by the manufacturer. CSI is a signal that the receiver may transmit to identify itself in a limited set of plain-text characters. DIS is a signal that the receiver must transmit to identify its standard set of facilities based on Table 2/T.30.

16. During Phase B the fax terminal which initiated the call (“sender”) and detected a valid DIS signal from the receiver may respond with signals such as “TSI” (transmitting subscriber identification), “DCS” (digital command signal), and “TCF” (training check). TSI is a signal that the sender may transmit to identify itself in a limited set of plain-text characters. DCS is a signal that the sender must transmit to identify a selection of the facilities indicated in the receiver’s DIS signal. TCF is a signal

that the sender must transmit to allow the receiver to train its demodulator in preparation for the upcoming Phase C signal from the sender.

17. Still in Phase B and following transmission of a TCF signal the sender expects to detect either a “CFR” (confirmation to receive) or an “FTT” (failure to train) signal from the receiver. If CFR is detected, then the sender proceeds to Phase C. If FTT is detected, then the sender repeats its portion of Phase B.

18. During Phase C the sender transmits encoded message data to the receiver as identified by the sender’s DCS signal. For practically all relevant fax systems, including those used in this matter, the message data being communicated in Phase C always corresponds to fax page image data.

19. During Phase D the sender transmits a signal such as “MPS” (multi page signal), “EOP” (end of procedure), or “PPS” (partial page signal) and expects to hear a signal such as “MCF” (message confirmation) from the receiver. It is the detection of this MCF signal that permits the sender to reliably produce a confirmation receipt for the fax transmission. If the receiver does not properly receive the data in Phase C then it will signal something else such as “PPR” (partial page request) or “RTN” (retrain negative), instead of MCF.

20. Once the sender has properly communicated all pages of a transmission then it will initiate a disconnection by signaling “DCN” (disconnect) and proceeding to Phase E and terminating the fax telephone call.

21. Although T.30 provides a mechanism for document retrieval through polling – where a document may be retrieved by the device which initiates the call – this mechanism is rarely supported or used in general and was never used for any of the fax communications in this matter. Therefore, all fax communications in this matter were initiated by the sender of documents by an attempt to transmit them to the intended receiver.

22. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED] NANPA and the FCC establish guidelines by which the Public Switched Telephone Network (PSTN) operates.

23. All fax communications in this matter involved fax receiving equipment which had the capacity to transcribe the fax image data to paper. In my professional experience I have not encountered any fax receiving equipment which does not have this capacity.

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

27. Consistent with common practice in the industry, I analyzed “Transmission Data” and “Phone Call Data” by importing that data into a database program and performing queries against that data.

28. The cumulative transmission data show that [REDACTED] faxes were sent to [REDACTED] distinct fax numbers between the dates 2012-10-30 and 2016-12-06.

29. Based on the evidence in the case the fax telephone number, [REDACTED] was assigned to Plaintiff, Matthew N. Fulton, and was connected to a fax machine

manufactured by Hewlett Packard, model LaserJet Pro 400 MFP M425dn. The user manual for this fax machine is given as Appendix C.

30. Plaintiff's counsel requested that I compile two separate sets of data in the form of spreadsheets from provided "Transmission Data" (ENC_00001519 through ENC_00001527, sequentially) and "Phone Call Data".

31. The first set of data was to contain summaries from "Transmission Data" for each distinct fax number where a date expressed in the [REDACTED] column preceded any date expressed in [REDACTED] for any record associated with that fax number and also preceded any date expressed in [REDACTED] from "Phone Call Data" for any record associated with that fax number (collectively identified as "first_response_date"). The sum of all [REDACTED] fields for each distinct fax number were to be provided as well as the sum of all [REDACTED] fields for each distinct fax number that occurred prior to "first_response_date" (identified as "deliveries_adjusted").

32. This first set of data contained [REDACTED] distinct fax numbers containing a total of [REDACTED] in the "deliveries" column and [REDACTED] in the "deliveries_adjusted" column. This list is provided as a Microsoft Excel spreadsheet with this report as Exhibit A along with sample pages in PDF copy in Appendix D1.

33. The second set of data was to contain summaries from "Transmission Data" for each distinct fax number where no record for that fax number included a

[REDACTED] and where no record involving that fax number appeared in “Phone Call Data”.

34. This second set of data contained [REDACTED] distinct fax numbers containing a total of [REDACTED] in the “deliveries” column. This list is provided as a Microsoft Excel spreadsheet with this report as Exhibit B along with sample pages in PDF copy in Appendix D2.

35. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

36. [REDACTED]

[REDACTED]

[REDACTED]

37. [REDACTED]

[REDACTED]

[REDACTED]

38. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

39. Based upon my knowledge of the T.30 fax standard protocol, explained above, based upon my professional experience in the fax industry, and in reasonable reliance on the aforementioned testimonies, it is my opinion to a reasonable degree of professional certainty that the summary fax transmission data provided in Exhibits A and B accurately represent fax communication between Enclarity/LexisNexis and the indicated recipient fax numbers.

40. All opinions set forth in this report are based upon a reasonable degree of professional certainty.

Dated: September 29, 2021

By: /s/ [Signature]

Appendix A

C. Lee Howard

Residence:

51 E Way to Tipperary St.
Shelton, WA 98584-6608
Phone: (360) 427-8160
Fax: (360) 427-8160
E-mail: faxguy@howardsilvan.com

Expertise:

- UNIX (Linux and BSD)
- Microsoft Windows (all versions including NT Server)
- Mac OS
- PC Hardware
- MySQL
- PHP
- E-mail processing, sendmail, postfix
- HylaFAX and fax protocol
- Apache, and BIND
- bash and common shell utilities
- C, C++, Java, Perl programming
- fax modem development
- networking
- VoIP, especially Asterisk administration
- electric vehicle charging protocol

Experience and Skills:

Mainpine, Inc.

CONSULTANT

2007 - 2008

- examine fax session logs of modem communication from various fax software for diagnostic purposes and provide feedback for fax software developers in problem resolution to make company's products more compatible with fax software
- evaluate company's hardware and firmware products, diagnose problems, and provide feedback for problem resolution in order to "harden" the products

SUPPORT MANAGER

2008 – 2009, 2009 - present

- oversee, manage, and lead a team of support technicians in troubleshooting and diagnosing problems with customers' use of company's products
- develop support procedures which greatly reduced the time necessary for diagnosing problems and made it possible for the hiring of persons inexperienced with fax to be trained on the procedures and work as support technicians
- train new employees as support technicians

SOFTWARE DEVELOPMENT LEAD

2008 - present

- design and lead development of fax software to be integrated with Microsoft Windows Fax Service which would fix numerous problems with Microsoft's implementation and support extended features in company's products which are not supported in Microsoft's implementation
- design and lead development of various software utilities and extensions to Microsoft Fax aimed at extending software features, improving customer support, and rapidly detecting hardware problems
- develop a suite of test software designed to be used to test post-production manufacturing of fax modem hardware

CHIEF TECHNICAL OFFICER

2012 - present

- guide the company's direction in product research and development and use of technology
- develop EV (electric vehicle) products such as a charging station controller and monitoring software

PRESIDENT

2020 - present

- streamline company operations to meet market changes
- design and develop internal database system to replace use of Netsuite CRM
- procure limited company financing
- operate accounts payable and human resources functions

HylaFAX.org and hylafax.sourceforge.net

2000 - present

DEVELOPER

- recognized the need for, authored, and maintained the HylaFAX HOWTO which became collectively the most-visited section on the HylaFAX.org website for many years
- led the creation of the HylaFAX+ software development project and website at Sourceforge net, including testing, hardening, and producing code releases and binary software packages
- updated and corrected much of manpage and online software documentation
- spearheaded software development efforts and coded patches to make HylaFAX functional on OpenBSD, Mac OS X, and RedHat Linux 7.2
- coded patches to place "From" fields on default fax cover sheets
- spearheaded development effort to build a priority scheduling mechanism for POSIX systems
- developed multiple enhancements to the code base, allowing functionality with various Cirrus Logic, 3Com/US Robotics, Hayes, Rockwell, Lucent, MultiTech, Zoom, AT&T, UMC, Prometheus, Practical Peripherals, Motorola, Eicon, and Zyxel modems
- researched, developed, and tested patches to the Class 1 code base resolving timing issues and adding new configuration settings which have contributed to the Class 1 code base surpassing most manufacturers' Class 2 firmware in faxing success ratios
- developed server-side job archiving
- provided key feedback and suggestions in the development of the Cypheus client
- provide timely response to posts on the hylafax-users and hylafax-devel mailing lists and assist in incorporating submitted patches into the code base and developing patches for reported code flaws
- initiated, hosted, and participated in development efforts watched by MultiTech engineers which resulted in HylaFAX support for Class 2.1, V.34-fax modems, and MultiTech's Real-Time Fax Compression Conversion mechanism – becoming the first public fax software to support these features
- developed HylaFAX support of extended resolutions up to 400 X 400 dpi in both fax sending and fax receiving
- developed HylaFAX support of error correction and MMR compression in fax Class 1 protocol, effectively making HylaFAX's Class 1 protocol more feature-rich than most modem manufacturers' fax Class 2 firmware protocols
- developed JBIG and JPEG data compression support in HylaFAX as well as led the development process for JBIG support in the libtiff TIFF library software
- developed HylaFAX support for receiving and sending of color faxes
- designed and developed SSL Fax feature and support

iaxmodem.sourceforge.net

2006 - present

DEVELOPER

- develop an entirely software-based Class 1 fax modem by using and modifying existing PBX and DSP libraries
- develop and maintain website content detailing software installation, configuration, and usage
- serve as mailing-list technical support response for software users

Bock Hatch & Oppenheim - Chicago, Illinois

2017 - present

EXPERT ON FAX

- produce expert opinions, technical expertise and consulting in Telephone Consumer Protection Act (TCPA) cases.

Anderson + Wanca - Rolling Meadows, Illinois

2010 - present

EXPERT ON FAX

- produce expert opinions in Telephone Consumer Protection Act (TCPA) cases.

Wells Rural Electric Cooperative – Wells, Nevada

2006 - 2014

CONSULTANT

- implement a company-wide backup system between Windows workstations and servers and UNIX backup servers

- implement a public mail proxy and spam-filtering server to a privately-accessible Microsoft Exchange Server
- seamlessly transition 300+ mail users and public company website from a hosting service to their own equipment
- provide recurring consultation and technical support to their technical staff for administering the UNIX services on their equipment including DNS, DHCP, SMTP, POP3, IP routing, etc.

Telechoice Solutions – Houston, Texas

2006 - 2008

CONSULTANT

- design, develop and deploy a system to reliably communicate faxes to and from a remote oil rig in the Gulf of Mexico via satellite internet connectivity – involved tight integration, modification, and development of PBX, soft modems, and fax software
- provide recurring consultation and technical support to their technical staff for administering the fax services on the equipment that they provide to their customers

Platinum Mortgage Partners – Honolulu, Hawaii

2006 - 2015

CONSULTANT

- remotely administer and maintain an internet router and other network services including Voice-over-IP equipment
- provide ongoing technical support assistance and consultation to office employees and managers
- design, develop and deploy a system whereby employees and agents can remotely connect to internal office network resources and work from outside the office

Pacific Home Finance – Honolulu, Hawaii

2006 - 2010

CONSULTANT

- remotely administer and maintain an internet router and other network services including Voice-over-IP equipment
- provide ongoing technical support assistance and consultation to office employees and managers

Abe Lee Realty – Honolulu, Hawaii

2006 - 2009

CONSULTANT

- remotely administer and maintain an internet router and other network services including Voice-over-IP equipment and the integration with multiple traditional analog phone lines.
- design, develop, and deploy an internet web and fax service site, servicing both incoming and outgoing faxing via an internet web site

Integrity Escrow and Title – Honolulu, Hawaii

2005 - 2009

CONSULTANT

- remotely administer and maintain an internet router and other network services including Voice-over-IP equipment and the integration with multiple traditional analog phone lines.
- provide ongoing technical support assistance and consultation to office employees and managers

Impact Services – Cincinnati, Ohio

2005 - present

CONSULTANT

- remotely administer a network of fax, file, PBX, web, and mail servers servicing several thousand users and handling tens of thousands of fax pages daily – delivering incoming faxes to recipients both via e-mail and via web site access
- design, develop, and deploy a replacement for the bulk of the network infrastructure, modernizing and improving functionality and reliability
- serve as call-in technical support for customers

Lexington Die Casting and Machining – Lakewood, New York

2004 - 2009

CONSULTANT

- installed, configured and remotely maintain a UNIX fax server connected to unique “analog DID” trunks providing individual fax numbers to company employees using HylaFAX delivering images via e-mail

Financial Management & Design – Brigham City, Utah

2004 – 2010

CONSULTANT

- built, configured, and maintained a UNIX internet server to provide internet access, mail services, web services, and remote desktop administration to several desktop workstations
- provide ongoing consultation and technical support services for workstation and networking issues

Mortgage Brokers Consortium – Honolulu, Hawaii

2001 - 2008

CONSULTANT

- replaced a dysfunctional existing fax system with HylaFAX server and Cypheus clients to deliver to and send faxes from a network of workstations
- develop and deploy an interstate network of automated fax servers and a browser-driven database to provide for weekly nationwide marketing-by-fax campaigns to a large client list
- built, installed, configured, seamlessly migrated, and maintain several UNIX internet servers to allow the business to host its own website, domain, dial-up, and mail services on its existing large-bandwidth frame-relay connection
- developed a redundant backup mechanism for large amounts of business data
- developed an on-line business application designed to handle traffic generated by the fax-based marketing
- designed, implemented, and maintain remote access systems, allowing employees and management to work from home, while traveling, and at remote office locations
- developed and maintain automated UNIX servers which continuously display marketing presentations on large display screens, integrating StarOffice applications with customized scripting
- developed and maintained a multi-office interstate and roaming-agent common phone system integrating voice-over-IP and traditional PSTN technologies

Plaza Home Mortgage – CA, WA, NM, TX, MA, AZ

2002 – present

CONSULTANT

- built, configured and remotely maintain numerous UNIX fax servers using HylaFAX to deliver incoming faxes to the network via e-mail
- provide consulting and networking services for troubleshooting disconnectivity problems

Lori Bonn Design – Oakland, California

2003 – 2010

CONTRACTOR

- supervised, directed, and maintain the development of the www.loribonn.com website
- configured and implemented authenticated SMTP services for the company’s mail server
- provide remote UNIX maintenance services

Rocky Mountain Surety – Evergreen, Colorado

2001 – 2004

CONSULTANT

- installed and configured HylaFAX server for outbound faxing on Linux PPC and Mac OS X (then an unsupported platform) for use in automated faxing of database-created PDF invoices and other business documents
- assist in developing browser-driven applications for creating PDF images, invoicing, and importing spreadsheet information into an SQL database

iFax, Inc.

2002 – 2003

CONTRACTOR

- reworked a troublesome two-system, 48-modem, fax server installation for a client in the financial

industry to eliminate failed fax receptions, correct fax recurring sending failures, and ensure delivery of a very large volume of incoming faxes directly to several network printers, saving the company thousands of dollars in lost business

- developed, for an international wireless service provider, HylaFAX support for Kyocera/Qualcomm mobile fax phones which suffered from a significant number of firmware problems and inconsistencies, requiring alterations to HylaFAX source code, communication protocol analysis, and troubleshooting
- developed HylaFAX enhancements to store caller identification information within HylaFAX statistical data tables, the fax file itself, and then to utilize that information at every statistical reporting opportunity

Deanox, Inc. – Logan, Utah

1998 - 2002

PRESIDENT/OWNER/GENERAL MANAGER

- successfully transitioned the business from a failing retail sales strategy to a service-oriented plan
- transitioned the business away from multiple separate and independent data systems into a consolidated and integrated sales, service, accounting, purchasing, and inventory solution
- built, installed, configured, and maintain multiple UNIX internet servers which hosted the company's web, domain, mail, printing, dial-up, and fax services
- implemented a fax-to-email gateway, delivering incoming faxes to the network
- developed an email-to-fax gateway which allowed in-use RelayFax Windows clients to deliver fax jobs to HylaFAX server despite RelayFax not being designed to do so by its authors
- managed (until January 2002) the day-to-day affairs of the business, including hiring, training, accounting, as well as involving myself in the day-to-day work of servicing and sales

Thoughtform Corporation – Bountiful, Utah

2000 – 2002

CONSULTANT

- networked over a dozen independent desktop workstations and used a UNIX internet server to provide broadband connectivity for all systems as well as host their own web and mail services.
- provided continued maintenance and technical support for network, server, and workstations

Trenton Feed – Trenton, Utah

2000 - 2001

CONSULTANT

- built, configured, and maintained a UNIX internet server to provide internet access and mail services to several desktop workstations
- built, configured, and maintained a Windows 2000 server to provide services for a proprietary database system

1Cache.com – Logan, Utah

2000 - 2001

CONSULTANT

- built, configured, and maintained a UNIX internet server to provide broadband connectivity for a dozen network desktop workstations
- configured and maintained a mailing list program to send marketing campaigns to tens of thousands of customers

Quality First Insurance – Logan, Utah

2001

CONSULTANT

- networked several desktop workstations to a broadband internet connection
- built, configured and maintained a UNIX fax server using HylaFAX to deliver incoming faxes to the network via e-mail

Rush Logistics – Chicago, Illinois

2001, 2002, 2005

CONSULTANT

- installed and configured HylaFAX server and clients on several UNIX servers and workstations for outbound faxing from a custom database application

iPub.com & Linden Works – Oakland, California

2001

CONSULTANT

- troubleshot and fixed a HylaFAX installation used for automated faxing of web-placed orders for their Pizza Boy service which was having troubles due to misconfiguration and an incompatibility between HylaFAX and a particular USR modem

Crystal Hot Springs – Honeyville, Utah

1993

CONSULTANT

- developed a graphical database program to track registrations, payments, and earnings for a resort campground

Education:

Utah State University

Logan, Utah

Fall 1992, 1995, 1996, 1997; Winter 1993, 1996, 1997; Spring 1993, 1996, 1997

Status: senior

Advisor: Donna Eckburg

Major: physics

Classes taken outside major: calculus, English, philosophy, psychology, computer science, mythology, Spanish, macroeconomics, physiology, and chemistry

Extracurricular: *Statesman* (university paper) “features” staff writer

Awards: academic tuition scholarship 1992, 1995

Other:

ClueCon 2006 Telecommunications Conference Speaker

ClueCon 2007 Telecommunications Conference Speaker

Omni Hotel, Chicago, Illinois

Upon invitation by conference organizers, spoke to conference attendees regarding specific difficulties involving fax and VoIP technologies and discussed potential solutions, in particular IAXmodem and HylaFAX.

Chile, Santiago South Mission

The Church of Jesus Christ of Latter-day Saints

Santiago, Chile, South America

Service: July 1993 through July 1995

Status: honorably released

Responsibilities: general proselyting, teaching, motivating, and service

Skills learned: communication, Spanish fluency, leadership, teamwork

Appendix B

I n t e r n a t i o n a l T e l e c o m m u n i c a t i o n U n i o n

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

T.30

(09/2005)

SERIES T: TERMINALS FOR TELEMATIC SERVICES

**Procedures for document facsimile
transmission in the general switched telephone
network**

ITU-T Recommendation T.30

ITU-T Recommendation T.30

Procedures for document facsimile transmission in the general switched telephone network

Summary

This Recommendation defines the procedures used by Group 3 facsimile terminals as defined in ITU-T Rec. T.4. These procedures enable documents to be transmitted on the general switched telephone network, international leased circuits and the Integrated Services Digital Network (ISDN). Further, these procedures allow communication to be manual or automatic and for document transmission to be requested alternatively with telephone conversation.

With this revision, the colour spaces defined in ITU-T Rec. T.30 will be aligned with those in ITU-T Rec. T.44. Additionally, the scope and applicability of T.30 and T.44-based facsimile applications are expanded. The following methods are defined for introducing T.44 YCC colour space to T.30.

- 1) New negotiation bit 119 "T.44 colour space" is added with new Note 83.
- 2) Note 39 (for bit 74 custom illuminant) and Note 40 (for bit 75 custom gamut range) are modified to reflect the addition of bit 119.

Source

ITU-T Recommendation T.30 was approved on 13 September 2005 by ITU-T Study Group 16 (2005-2008) under the ITU-T Recommendation A.8 procedure.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure e.g. interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

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As of the date of approval of this Recommendation, ITU had received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

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Introduction

- i) This Recommendation is intended to apply to document facsimile terminals covered by ITU-T Rec. T.4. It describes the procedures and signals to be used where facsimile terminals are operated over the general switched telephone network. When an existing terminal is operating in a non-ITU-T manner, it shall not interfere with a terminal operating in accordance with the T-series Recommendations.
- ii) Arrangements for automatic calling/answering on the general switched telephone network have been aligned as closely as possible with those described in the V-series Recommendations for data terminal equipment.
The answering procedures for multifunction terminal configurations are contained in Annex D.
- iii) While there are eight possible operating methods (see Table 1), each may be described by five separate and consecutive phases:
 - Phase A:* Call set-up.
 - Phase B:* Pre-message procedure for identifying and selecting the required facilities.
 - Phase C:* Message transmission (includes phasing and synchronization where appropriate).
 - Phase D:* Post-message procedure including end-of-message and confirmation and multi-document procedures.
 - Phase E:* Call release.
- iv) For digital document facsimile terminals conforming to ITU-T Rec. T.4, the binary coded system defined in this Recommendation shall be the standard signalling arrangement.
- v) The binary coded signalling system is based on a High Level Data Link Control (HDLC) format developed for data transmission procedures. The basic HDLC structure consists of a number of frames, each of which is subdivided into a number of fields. It provides for frame labelling, error checking and confirmation of correctly received information and the frames can be easily extended if this should be required in the future.
- vi) The transmission of the facsimile message itself (phase C) will be according to the modulation system described in the appropriate Recommendation for the facsimile terminal.

ITU-T Recommendation T.30

Procedures for document facsimile transmission in the general switched telephone network¹

The ITU-T,

considering

- a) that facilities exist for facsimile transmission over the general switched telephone network;
- b) that such facsimile transmission may be requested either alternatively with telephone conversation or when either or both terminals are not attended;
- c) that for this reason the operations involved in establishing and/or releasing a facsimile call should be capable of automatic operation,

unanimously declares the view

that the facsimile terminal should be designed and operated according to the following standards.

1 Scope

1.1 General

1.1.1 This Recommendation is concerned with the procedures which are necessary for document transmission between two facsimile terminals in the general switched telephone network.

These procedures essentially comprise the following:

- call establishment and call release;
- compatibility checking, status and control command;
- checking and supervision of line conditions;
- control functions and facsimile operator recall.

1.1.2 Only the procedures with their corresponding signals are specified in this Recommendation.

1.2 Classification of operating methods

1.2.1 This Recommendation regulates the operational sequence of manually operated facsimile terminals as well as of automatic terminals.

The automatic facsimile terminal is understood to be a terminal which is capable of performing all procedures (listed in 1.1) automatically. In this case, an operator is not necessary.

If, however, an operator is required for any of these procedures, the terminal must be regarded as a manually operated-terminal.

1.2.2 Based upon all combinations which may result from the fact that there are manually operated terminals and automatic facsimile terminals, the operating methods shown in Table 1 are possible.

¹ Facsimile terminals referred to as Group 3 in this Recommendation are those conforming to ITU-T Rec. T.4.

Table 1/T.30

Method No.	Description of operating method	Direction of facsimile transmission	Overall designation
1	<i>Manual</i> operation at calling terminal and	Calling terminal <i>transmits to</i> called terminal	1-T
	<i>Manual</i> operation at called terminal	Calling terminal <i>receives from</i> called terminal	1-R
2	<i>Manual</i> operation at calling terminal and	Calling terminal <i>transmits to</i> called terminal	2-T
	<i>Automatic</i> operation at called terminal	Calling terminal <i>receives from</i> called terminal	2-R
3	<i>Automatic</i> operation at calling terminal and	Calling terminal <i>transmits to</i> called terminal	3-T
	<i>Manual</i> operation at called terminal	Calling terminal <i>receives from</i> called terminal	3-R
4	<i>Automatic</i> operation at calling terminal and	Calling terminal <i>transmits to</i> called terminal	4-T
	<i>Automatic</i> operation at called terminal	Calling terminal <i>receives from</i> called terminal	4-R
4 bis	<i>Automatic</i> operation using the procedures defined in ITU-T Rec. V.8 at calling terminal and	Calling terminal <i>transmits to</i> called terminal using the procedures defined in ITU-T Rec. V.8	4-T
	<i>Automatic</i> operation using the procedures defined in ITU-T Rec. V.8 at called terminal	Calling terminal <i>receives from</i> called terminal using the procedures defined in ITU-T Rec. V.8	4-R
NOTE – There may also be operating methods which will allow messages to be received by more than one terminal (multipoint connection).			

1.3 Terminal identification

1.3.1 For the purpose of classifying an automatic facsimile terminal as a non-speech terminal, a tone must be transmitted to line. As both automatic calling and called facsimile terminals transmit tones to line during call establishment, a normal telephone user who becomes inadvertently connected to one will receive tone signals for a period of sufficient duration to indicate clearly to him that he is incorrectly connected.

1.3.2 Additionally an automatic verbal announcement may be used which can provide terminal identification.

1.4 General provisions

1.4.1 The control signals specified in this Recommendation have been chosen in such a way that the telephone service is not affected.

1.4.2 If any malfunction of the facsimile procedures described in this Recommendation is detected, the call should be released.

1.4.3 Where the called destination is an automatic facsimile terminal which is not ready or not able to operate, the call should not be answered automatically.

1.4.4 This Recommendation includes procedures for switching from facsimile to speech. However, speech facilities may be omitted if this is permitted by the regulations of the Administrations.

1.5 Optional provisions

1.5.1 The operator at each terminal may have the possibility of calling the other terminal at any time during the progress of the facsimile procedure (see 2.2).

1.5.2 The procedures in this Recommendation allow a facsimile terminal to transmit and/or receive several documents successively without the aid of an operator.

1.5.3 This Recommendation includes procedures for incorporating a unique terminal identification command if required to prevent unauthorized terminals from demanding a message.

If enhanced security is required, this may be provided by the use of the non-standard facilities frame.

1.6 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- ITU-T Recommendation G.726 (1990), *40, 32, 24, 16 kbit/s Adaptive Differential Pulse Code Modulation (ADPCM)*.
- ITU-T Recommendation T.4 (2003), *Standardization of Group 3 facsimile terminals for document transmission*.
- ITU-T Recommendation T.6 (1988), *Facsimile coding schemes and coding control functions for Group 4 facsimile apparatus*.
- ITU-T Recommendation T.36 (1997), *Security capabilities for use with Group 3 facsimile terminals*.
- ITU-T Recommendation T.43 (1997), *Colour and gray-scale image representations using lossless coding scheme for facsimile*.
- ITU-T Recommendation T.44 (2005), *Mixed Raster Content (MRC)*.
- ITU-T Recommendation T.81 (1992) | ISO/IEC 10918-1:1994, *Information technology – Digital compression and coding of continuous-tone still images – Requirements and guidelines*.
- ITU-T Recommendation T.82 (1993) | ISO/IEC 11544:1993, *Information technology – Coded representation of picture and audio information – Progressive bi-level image compression*.
- ITU-T Recommendation T.85 (1995), *Application profile for Recommendation T.82 – Progressive bi-level image compression (JBIG coding scheme) for facsimile apparatus*.
- ITU-T Recommendation T.434 (1999), *Binary file transfer format for the telematic services*.
- ITU-T Recommendation V.8 (2000), *Procedures for starting sessions of data transmission over the public switched telephone network*.

- ITU-T Recommendation V.17 (1991), *A 2-wire modem for facsimile applications with rates up to 14 400 bit/s*.
- ITU-T Recommendation V.27 *ter* (1988), *4800/2400 bits per second modem standardized for use in the general switched telephone network*.
- ITU-T Recommendation V.29 (1988), *9600 bits per second modem standardized for use on point-to-point 4-wire leased telephone-type circuits*.
- ITU-T Recommendation V.33 (1988), *14 400 bits per second modem standardized for use on point-to-point 4-wire leased telephone-type circuits*.
- ITU-T Recommendation V.34 (1998), *A modem operating at data signalling rates of up to 33 600 bit/s for use on the general switched telephone network and on leased point-to-point 2-wire telephone-type circuits*.

The referenced RFC documents contain provisions that are themselves described in yet other documents and which through indirect reference constitute provisions of this Recommendation. A list of the status of Internet RFCs and updates to other RFCs is regularly published.

- IETF RFC 822 (1982), *Standard for the format of ARPA Internet text messages*.
- IETF RFC 1738 (1994), *Uniform Resource Locators (URL)*.

2 Terms and definitions

This Recommendation defines the following terms:

2.1 facsimile terminal main functions: One or more terminals at the end of the line providing three main functions.

2.1.1 call establishment and call release: The establishment and release of a connection according to the normal rules of using the general switched telephone network.

2.1.2 procedure: To identify, to supervise and to control the facsimile transmission according to a protocol.

2.1.3 message transmission: To transmit and/or receive the facsimile message.

2.2 Time sequence of a facsimile call

See Figure 1.

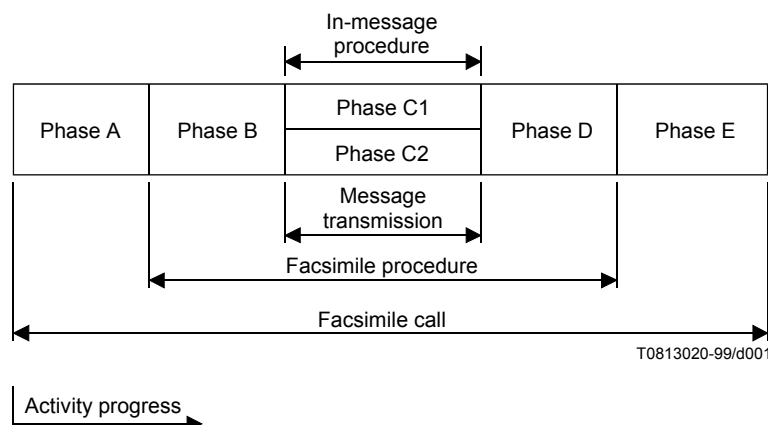


Figure 1/T.30

2.3 Description of phases

2.3.1 Phase A – Call establishment

Call establishment can be realized manually and/or automatically.

2.3.2 Phase B – Pre-message procedure

The pre-message procedure consists of the identification of capabilities and the commanding of the chosen conditions as well as the confirmation of acceptable conditions.

When connection is established between a terminal operating in accordance with this Recommendation and a terminal operating in a non-ITU-T manner, the terminals should disconnect before the in-message procedure unless both terminals include optional, compatible procedures.

2.3.2.1 Identification section

- capabilities identification;
- confirmation for reception;
- terminal identification (option);
- non-standard facilities identification (option).

2.3.2.2 Command section

- capabilities command;
- training;
- synchronization;

as well as the following optional commands:

- non-standard facilities command;
- terminal identification command;
- polling (send) command;
- echo suppressor disabling.

2.3.3 Phase C1 – In-message procedure

The in-message procedure takes place at the same time as message transmission and controls the complete signalling for in-message procedure, e.g., in-message synchronization, error detection and correction and line supervision.

2.3.4 Phase C2 – Message transmission

The message transmission procedure is covered by ITU-T Rec. T.4.

2.3.5 Phase D – Post-message procedure

The post-message procedure includes information regarding:

- end-of-message signalling;
- confirmation signalling;
- multipage signalling;
- end-of-facsimile procedure signalling.

2.3.6 Phase E – Call release

Call release shall be realized manually and/or automatically.

3 Description of a facsimile call

3.1 Phase A – Call establishment²

The establishment of a facsimile call may be realized either manually, if an operator is in attendance, or automatically. To accomplish this, four operating methods have been defined.

For automatic operation at the calling side, the timer T0 is used for the terminals which conform to the 1997 and later versions of this Recommendation. Timer T0 is detailed in 5.4.3.1.

3.1.1 Operating method 1

Manual operation at both the calling and called terminal. Figure 2 indicates the operators' actions required to establish a call.

3.1.2 Operating method 2

Manual operation at the calling terminal and automatic operation at the called terminal. Figure 3 indicates the operator's and terminal actions required to establish a call.

3.1.3 Operating method 3

Automatic operation at the calling terminal and manual operation at the called terminal. Figure 4 indicates the operator's and terminal actions required to establish a call.

3.1.4 Operating method 4

Automatic operation at both the calling and called terminals. Figure 5 indicates the actions required by the terminal to establish a call.

3.1.5 Operating method 4 *bis*

3.1.5.1 Operating method 4 *bis* a

Automatic operation at both the calling and called terminals when either or both the calling and called terminal are capable of V.8 and V.34 operation. Figure 6a indicates the actions required by the terminal to establish a call.

3.1.5.2 Operating method 4 *bis* b

Manual operation at the calling and automatic operation at the called terminal when either or both the calling and called terminals are capable of V.8 and V.34 operation. Figure 6b indicates the actions required by the terminal to establish a call.

3.2 Phases B, C and D – Facsimile procedure

When entering phase B, the following rules should be adhered to:

All manual receiving terminals and all auto-answering terminals must enter phase B by identifying their capabilities (i.e., Node R of the flow diagram in 5.2). All manual transmitting terminals and all auto-calling terminals must enter phase B prepared to detect the capabilities and issue the appropriate mode setting command (i.e., Node T of the flow diagram in 5.2). To allow for operating method 2-R, the delay between the transmission of the digital identification signals shall be $4.5\text{ s} \pm 15\%$ when sent from a manual receiving terminal.

The detailed information pertaining to the binary coded facsimile procedures is contained in clause 5.

² See Appendix I for abbreviations used in this Recommendation.

3.2.1 Signal sequences

The recommended system utilizes the interchange of signals between the two terminals to verify compatibility and assure operation. To do this, the called terminal identifies its capabilities. The calling terminal responds to this accordingly with a command. Now the transmitter continues phase B.

Following the transmission of the message, the transmitter sends an end-of-message signal and the receiver confirms reception. Multiple documents can then be transmitted by the repetition of this procedure.

The flow of signals is shown in Figure 7 for the configuration where the calling terminal is transmitting.

The condition where the calling terminal is to receive documents is shown in Figure 8.

3.3 Phase E – Call release

Call release occurs after the last post-message signal of the procedure or under certain conditions, for example:

3.3.1 Time-out

When a signal as specified by the facsimile procedure is not received within the specified time-out period, the terminal may signal to the operator (if one is in attendance) or disconnect the telephone connection. The appropriate time-out periods are specified in clause 5.

3.3.2 Procedural interrupt

The facsimile procedure may be interrupted by sending a procedural interrupt signal, by notifying the attending operator or by disconnecting the connection. The signal is defined in clause 5.

3.3.3 Command

The call may be immediately terminated by the appropriate commands, as specified in clause 5.

Call event No.	Calling terminal	Called terminal
1	Operator hears dial tone and dials desired number	Call rings and operator answers the call Verbal identification
2	Operator hears ringing tone	
3	Verbal identification	
4	Facsimile terminal is switched to line and transmits CNG	Facsimile terminal is switched to line
5	Begin facsimile procedure (see clauses 4 and/or 5)	Begin facsimile procedure (see clauses 4 and/or 5)

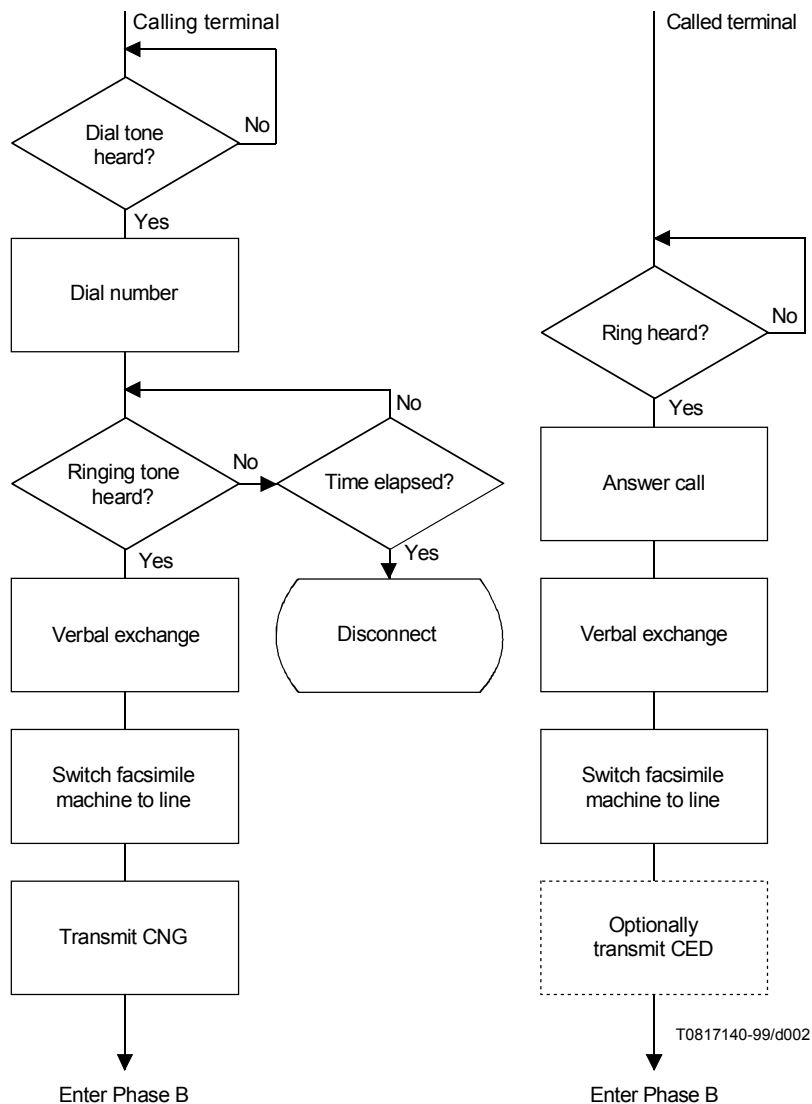


Figure 2/T.30 – Call establishment, operating method 1

Call event No.	Calling terminal	Called terminal
1	Operator hears dial tone and dials desired number	Terminal detects ring and answers the call Optionally, a recorded verbal announcement may be transmitted Transmit CED
2	Operator hears ringing tone	
3		
4	Operator hears CED or an optional recorded announcement and facsimile terminal is switched to line and transmits CNG	
5	Begin facsimile procedure (see clauses 4 and/or 5)	Begin facsimile procedure (see clauses 4 and/or 5)

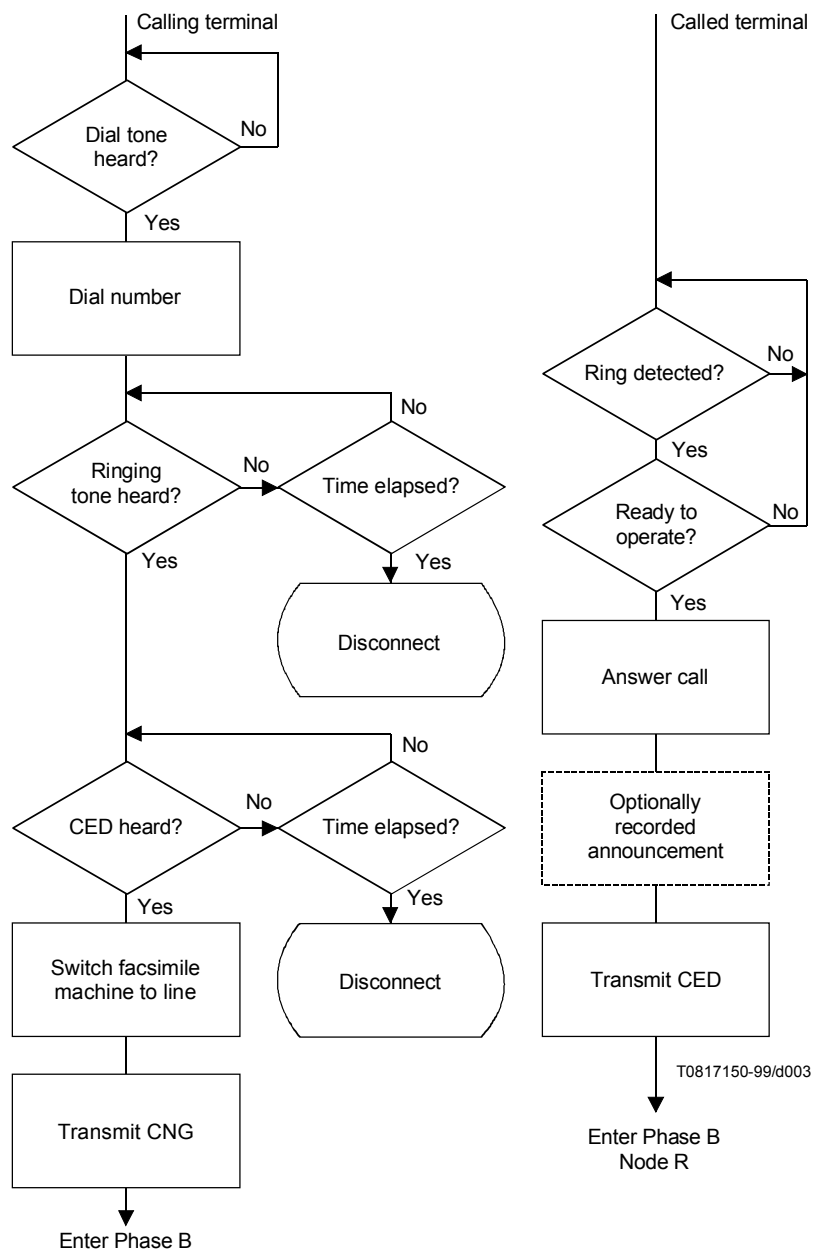


Figure 3/T.30 – Call establishment, operating method 2

Call event No.	Calling terminal	Called terminal
1	Terminal detects dial tone and dials desired number (Note). To clearly indicate to a called operator that he is connected to a facsimile terminal or to a normal telephone user that he is inadvertently connected, CNG will be transmitted to line during the time that signals are attempted to be detected	Call rings and operator answers the call Operator detects CNG and switches facsimile terminal to line (optionally CED may be generated)
2		
3		
4	Begin facsimile procedure (see clauses 4 and/or 5)	Begin facsimile procedure (see clauses 4 and/or 5)
NOTE – An alternative procedure may be specified by Administrations.		

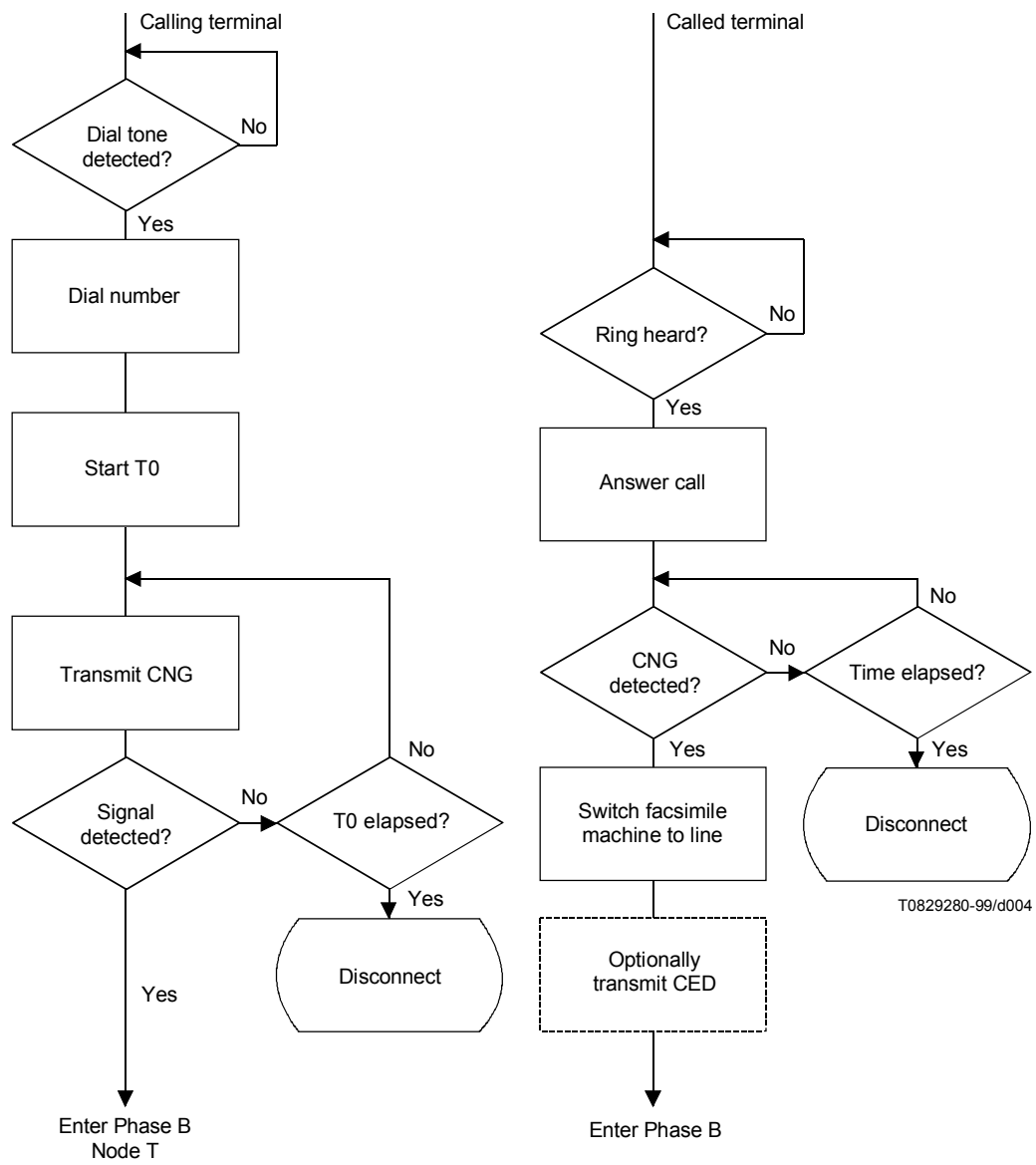


Figure 4/T.30 – Call establishment, operating method 3

Call event No.	Calling terminal	Called terminal
1	Terminal detects dial tone and dials desired number (Note). To clearly indicate to a normal telephone user that he is inadvertently connected, CNG will be transmitted to line during the time that signals are attempted to be detected	Terminal detects ring and answers the call Optionally, a recorded verbal announcement may be transmitted Transmit CED
2		
3		
4		
5	Begin facsimile procedure (see clauses 4 and/or 5)	Begin facsimile procedure (see clauses 4 and/or 5)
NOTE – An alternative procedure may be specified by Administrations.		

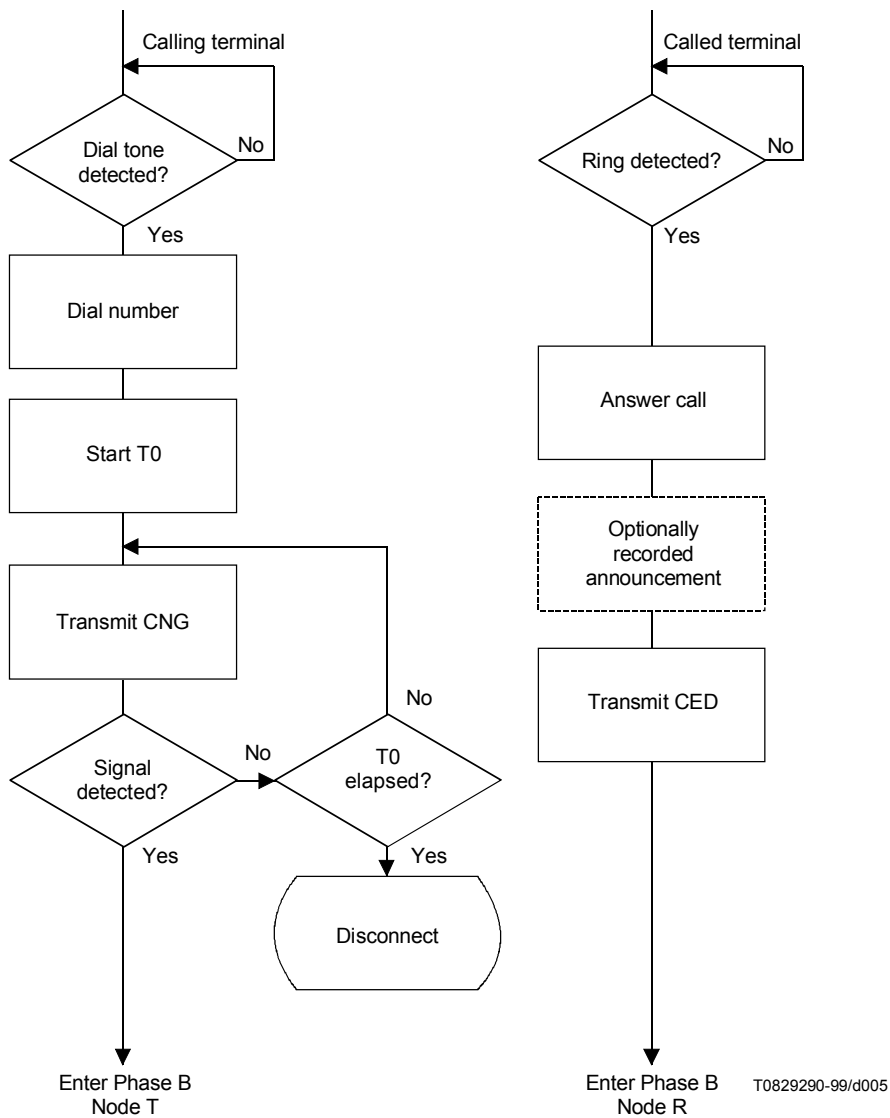


Figure 5/T.30 – Call establishment, operating method 4

Call event No.	Calling terminal	Called terminal
1	Terminal detects dial tone and dials desired number. To clearly indicate to a normal telephone user that he is inadvertently connected, CNG will be transmitted during the time that signals are attempted to be detected	Terminal detects ring and answers the call Optionally, a recorded verbal announcement may be transmitted Transmit ANSam
2		
3		
4	Transmit CM	Begin T.30 Annex F if half-duplex or Annex C if duplex procedures
5		
6		
	Begin T.30 Annex F if half-duplex or Annex C if duplex procedures	

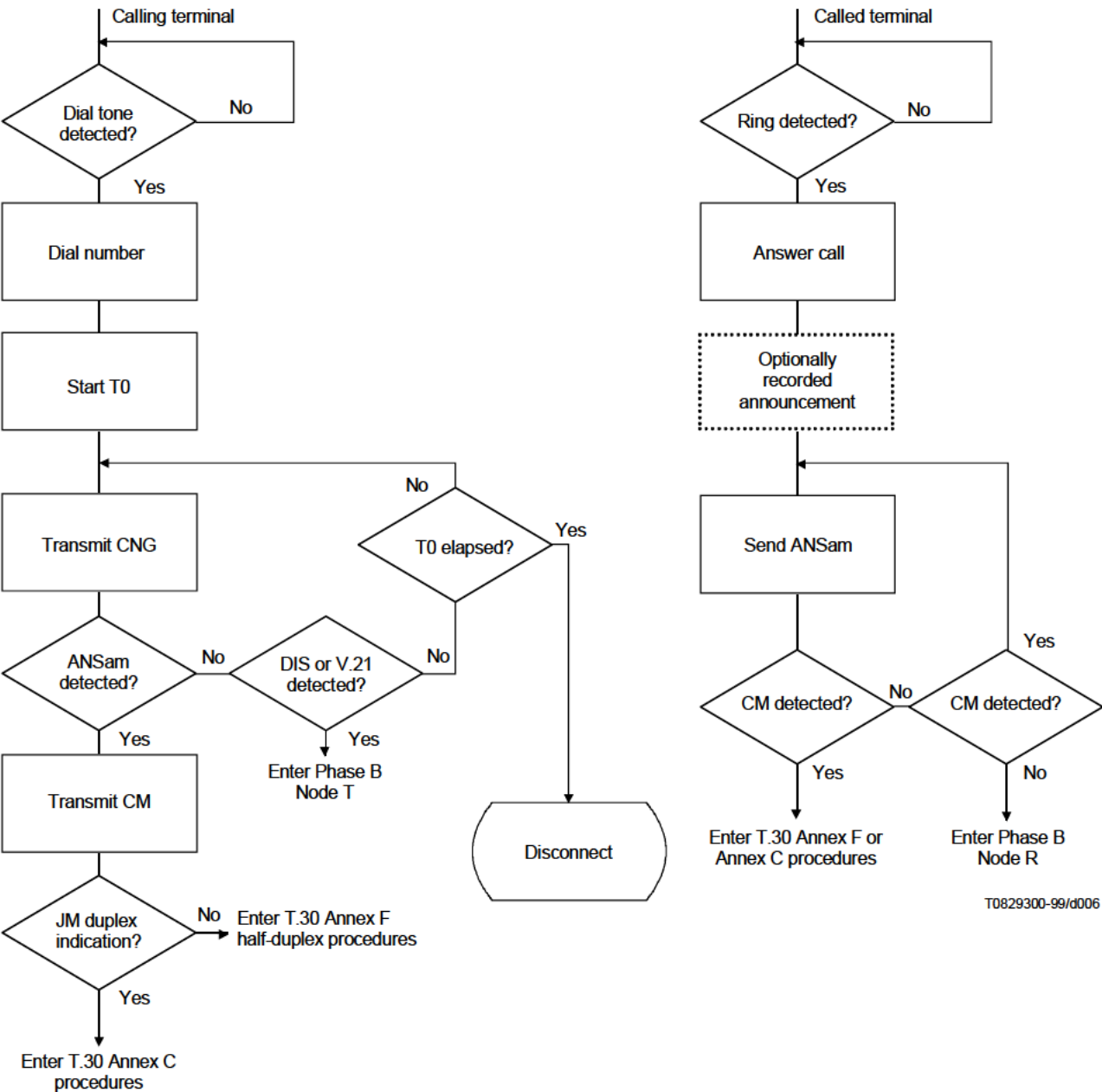


Figure 6a/T.30 – Call establishment, operating method 4 bis a

Call event No.	Calling terminal	Called terminal
1	Operator detects dial tone and dials desired number	Terminal detects ring and answers the call Optionally, a recorded verbal announcement may be transmitted Transmit ANSam
2		
3		
4	Operator switches the terminal to line CNG will be transmitted during the time that signals are attempted to be detected	Transmit DIS
5		
6	Terminal detects V.8 capability and transmits CI Begin T.30 Annex F if half-duplex or Annex C if duplex procedures	Begin T.30 Annex F if half-duplex or Annex C if duplex procedures
7		
8		

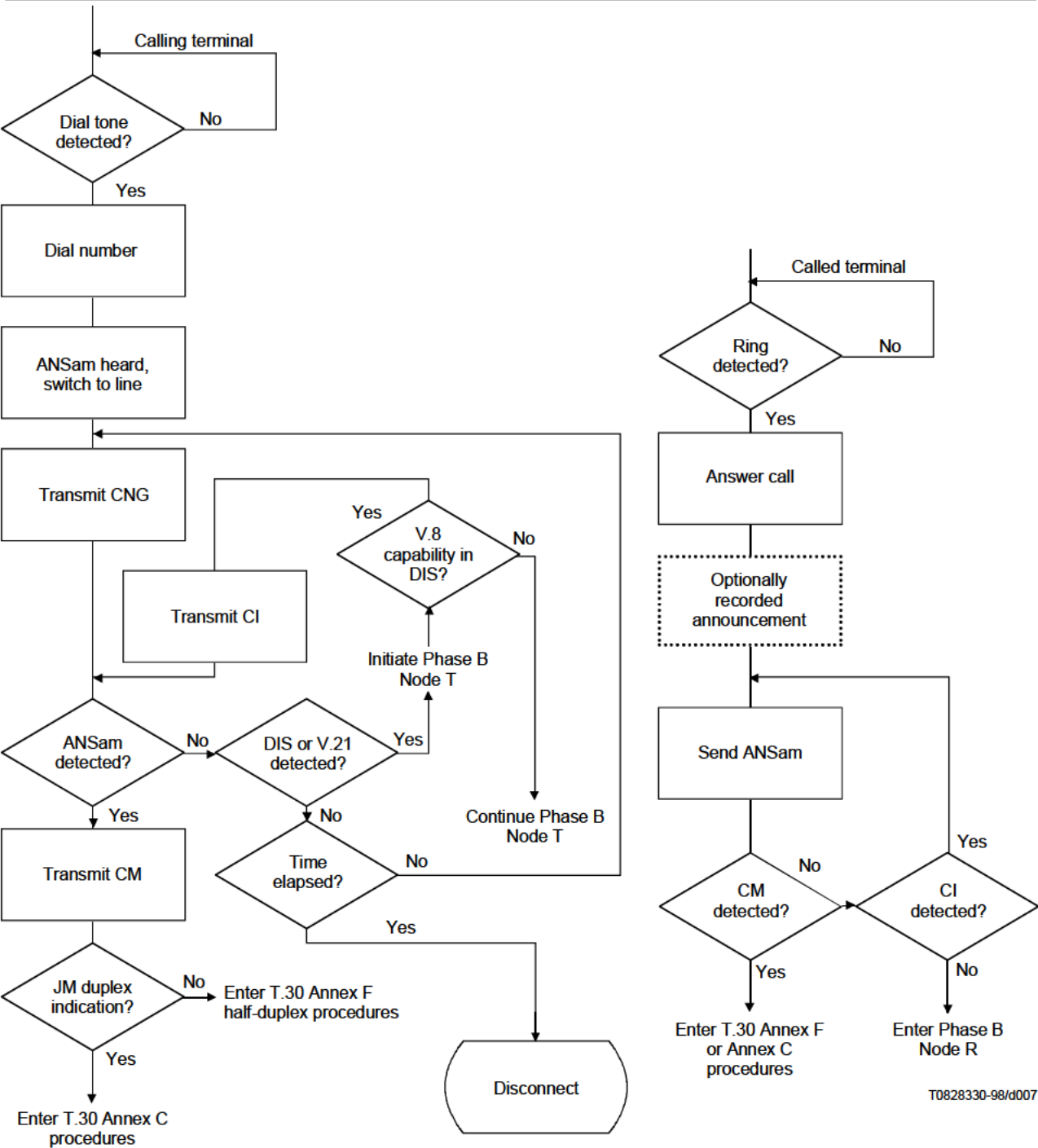


Figure 6b/T.30 – Call establishment, operating method 4 bis b

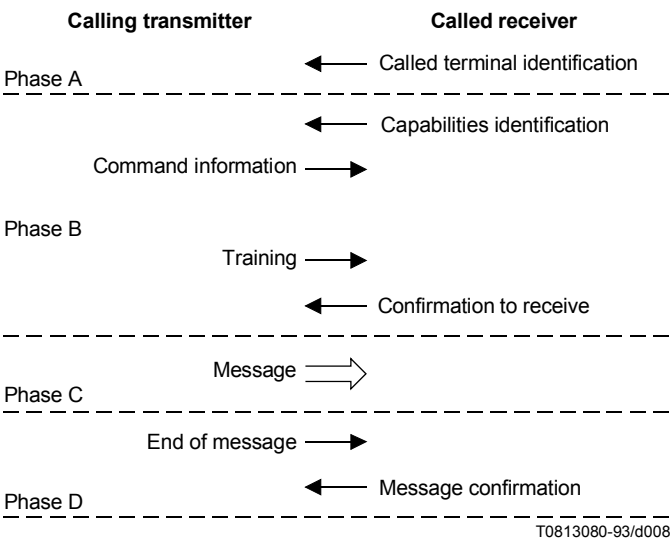


Figure 7/T.30 – Calling terminal is transmitting

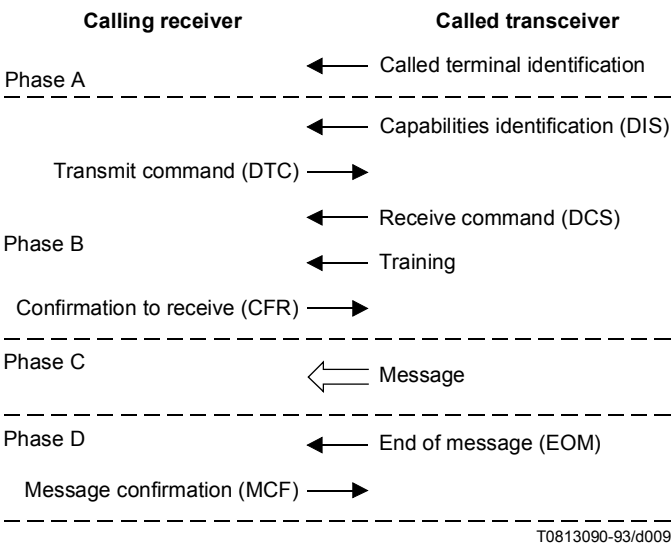


Figure 8/T.30 – Calling terminal is receiving

4 Tonal signal functions and formats

4.1 Automatic answer sequence

Group 3 facsimile terminals may automatically answer calls in accordance with either 4.1.1 or 4.1.2.

4.1.1 For a period of at least 0.2 s after it is connected to line, it shall transmit no signal. After this period, it shall transmit the Called terminal identification (CED) answer tone, a continuous 2100 Hz ± 15 Hz tone for a duration of not less than 2.6 s and not more than 4.0 s and then follow the procedures defined in clause 5. The terminal delays for a period of 75 ± 20 ms after transmitting the CED tone before transmitting further signals.

4.1.2 If the terminal incorporates the optional procedures defined in ITU-T Rec. V.8, it transmits the answer tone ANSam defined in ITU-T Rec. V.8 and then follows the procedures defined in clause 6.

NOTE – Some terminals which conform to the pre-1996 versions of this Recommendation may transmit a different automatic answer sequence to that described above. This alternative sequence is shown in Figure III.1.

4.2 Calling tone (CNG)

Format

See Figure 9.

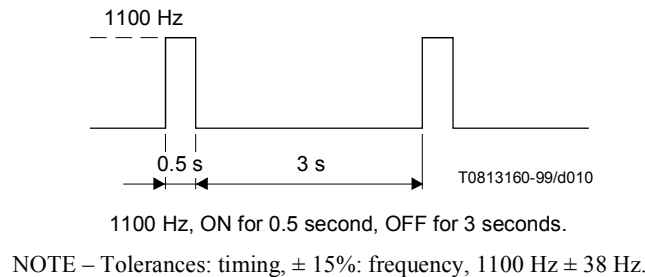


Figure 9/T.30

Function

- 1) To indicate a calling non-speech terminal. This signal is mandatory for automatic calling terminals and for manual terminals. However, manual calling terminals conforming to the 1993 and previous versions of this Recommendation may not transmit this signal.
- 2) To indicate that the terminal is in the transmit mode and is ready to transmit on receipt of the Digital Identification Signal (DIS).
- 3) Where a terminal is capable of sending more than one document without the necessity of operator assistance, this signal may be transmitted between documents whilst the transmitter is waiting for the Digital Identification Signal (DIS). It would indicate to an operator that the transmitter was still connected to line.

5 Binary coded signalling procedure

300 bits per second is the standard data signalling rate for the transmission of binary coded procedural data.

Except as otherwise noted, the binary coded control procedures should be transmitted in a synchronous mode on the general switched telephone network at 300 bits per second $\pm 0.01\%$ utilizing the characteristics of V.21 channel No. 2 modulation system. For the tolerances, see clause 3/V.21. Signal generators should have a distortion not exceeding 1% and the control signal receivers should accept signals with a distortion not exceeding 40%.

An error correction capability is utilized as a recognized option. This procedure is defined in Annex A.

A capability to operate over public digital networks or on the GSTN using duplex modulation systems is provided as a standardized option. This procedure is defined in Annex C.

NOTE 1 – The transmission of training, TCF, and all in-message signals, shall be at the data rate of the high-speed message channel.

NOTE 2 – It is acknowledged that existing terminals may not conform in all aspects to this Recommendation. Other methods may be possible as long as they do not interfere with the recommended operation.

NOTE 3 – Transmission of signals utilizing the modulation system of V.21 channel No. 2 should be followed by a delay of 75 ± 20 ms before the signalling, utilizing a different modulation system, commences (e.g., the delay between DCS and the V.27 *ter* or V.29 training sequence).

NOTE 4 – The transmission of signalling utilizing the modulation systems of ITU-T Recs V.27 *ter*, V.29, or V.17 should be followed by a delay of 75 ± 20 ms before the signalling, utilizing a different modulation system, commences (e.g., the delay between RTC and MPS).

NOTE 5 – Terminals using the modulation system defined in ITU-T Rec. V.17 (as specified by bits 11, 12, 13 and 14 of Table 2/V.17) shall use the short resynchronization sequence defined in Table 3/V.17 for all trellis mode training except during a TCF message and the first high-speed message after a CTC/CTR ECM message sequence. The long synchronization sequence shall be used in the TCF and the first high-speed message after the CTC/CTR sequence.

5.1 Description

Phases B, C and D

Case 1: Calling terminal wishes to transmit (see Figure 7).

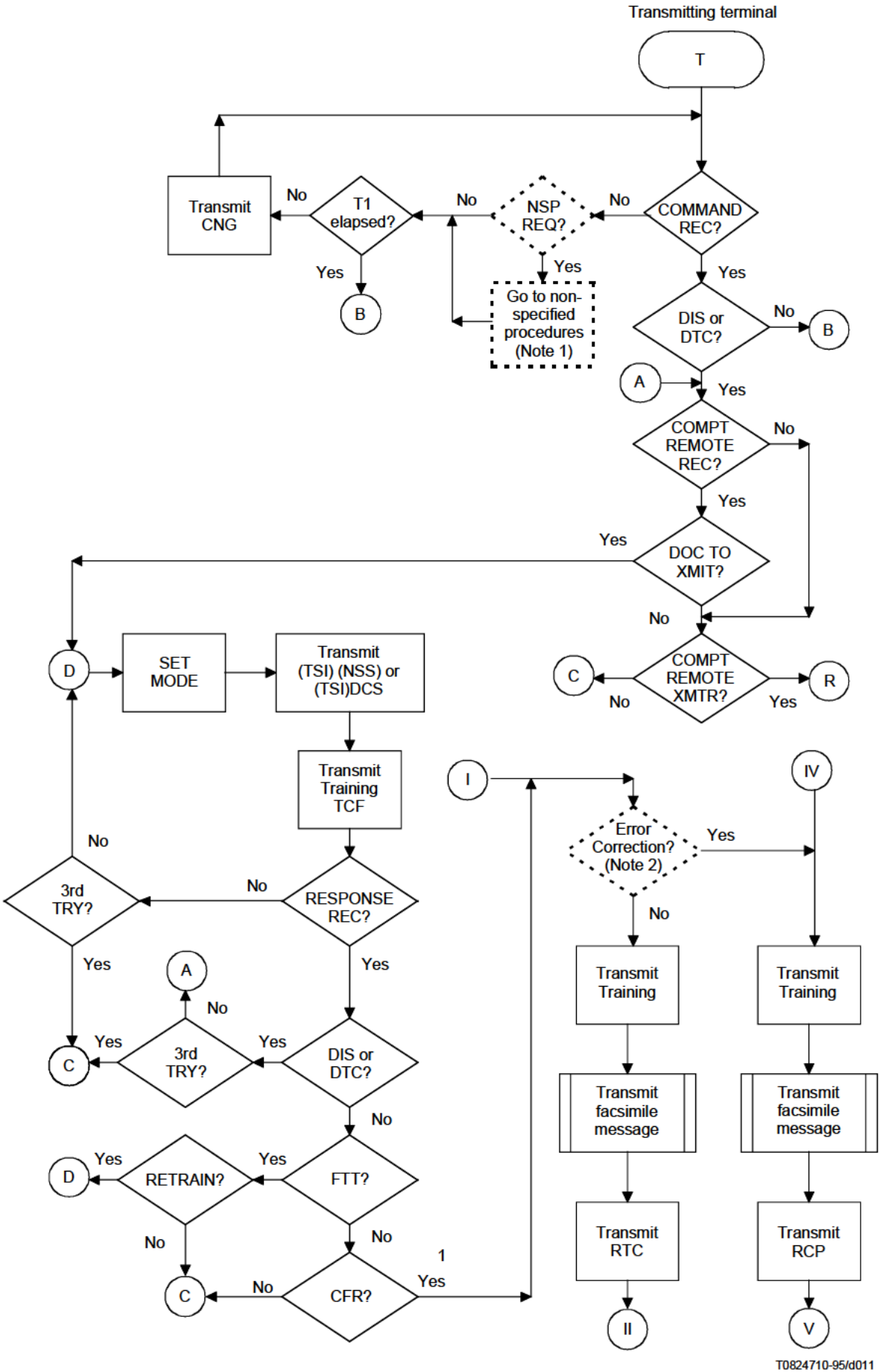
Calling terminal	Called terminal
2. DIS detected	1. Transmit DIS
3. Transmit DCS	4. DCS detected
6. Transmit training	5. Select mode
9. Detect CFR	7. Training
10. Transmit message	8. Transmit CFR
12. At the end of message send either: a) EOM; or b) EOP; or c) MPS; or d) PRI-Q; or e) PPS-NULL; or f) PPS-MPS; or g) PPS-EOM; or h) PPS-EOP; or i) PPS-PRI-Q	11. Receive message
	13. Detect EOM, EOP, MPS, PRI-Q, PPS-NULL, PPS-MPS, PPS-EOM, PPS-EOP or PPS-PRI-Q
	14. Transmit one of the confirmation signals of post-message responses (see 5.3.6.1.7)
NOTE – Binary coded signals must be preceded by a preamble (see 5.3.1).	

Case 2: Calling terminal wishes to receive (see Figure 8).

Calling terminal	Called terminal
2. DIS detected	1. Transmit DIS
3. Transmit DTC	4. DTC detected
6. DCS detected	5. Transmit DCS
7. Select mode	8. Transmit training
9. Training	11. Detect CFR
10. Transmit CFR	12. Transmit message
13. Receive message	14. At the end of message send either: a) EOM; or b) EOP; or c) MPS; or d) PRI-Q; or e) PPS-NULL; or f) PPS-MPS; or g) PPS-EOM; or h) PPS-EOP; or i) PPS-PRI-Q
15. Detect EOM, EOP, MPS, PRI-Q, PPS-NULL, PPS-MPS, PPS-EOM, PPS-EOP or PPS-PRI-Q	
16. Transmit one of the confirmation signals of post-message responses (see 5.3.6.1.7)	

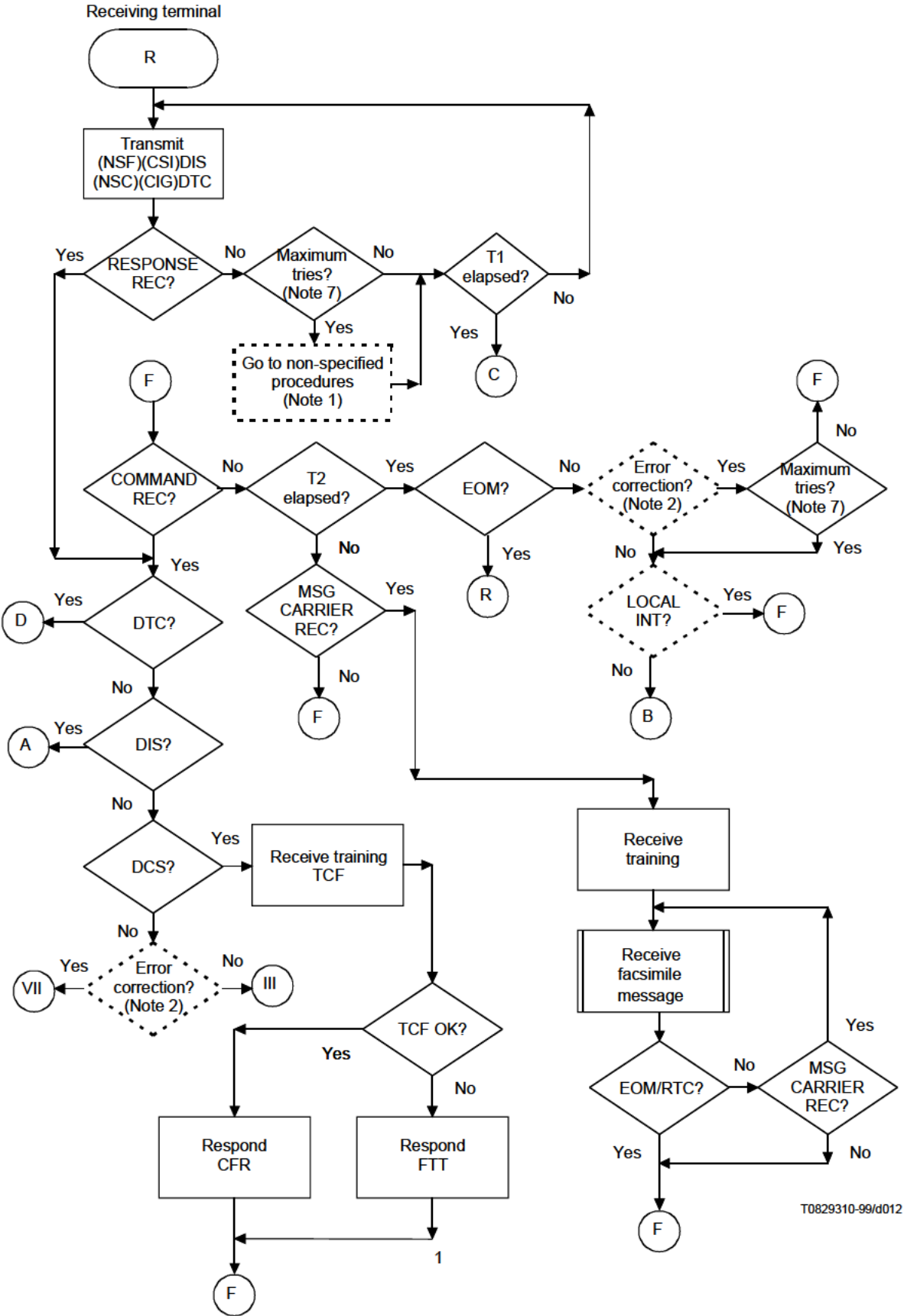
5.2 Flow diagrams – Figures 5-2a to 5-2x (see also Appendix IV)

For the Notes and an explanation of terms to the flow diagrams, see 5.2.1.



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Figure 5-2a/T.30



NOTE – The last command, except RR, was one of EOM, PPS-EOM or EOR-EOM?

Figure 5-2b/T.30

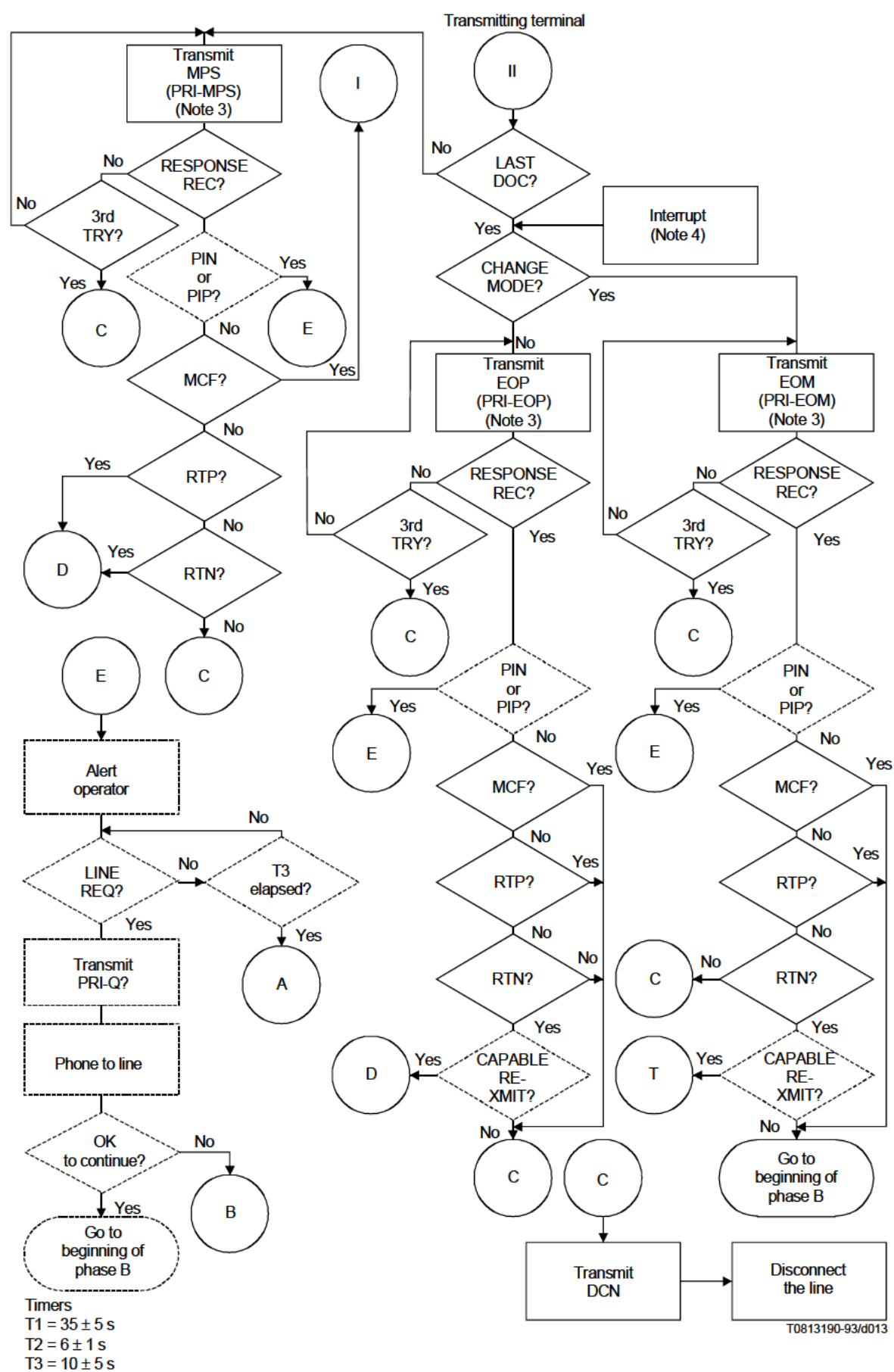


Figure 5-2c/T.30

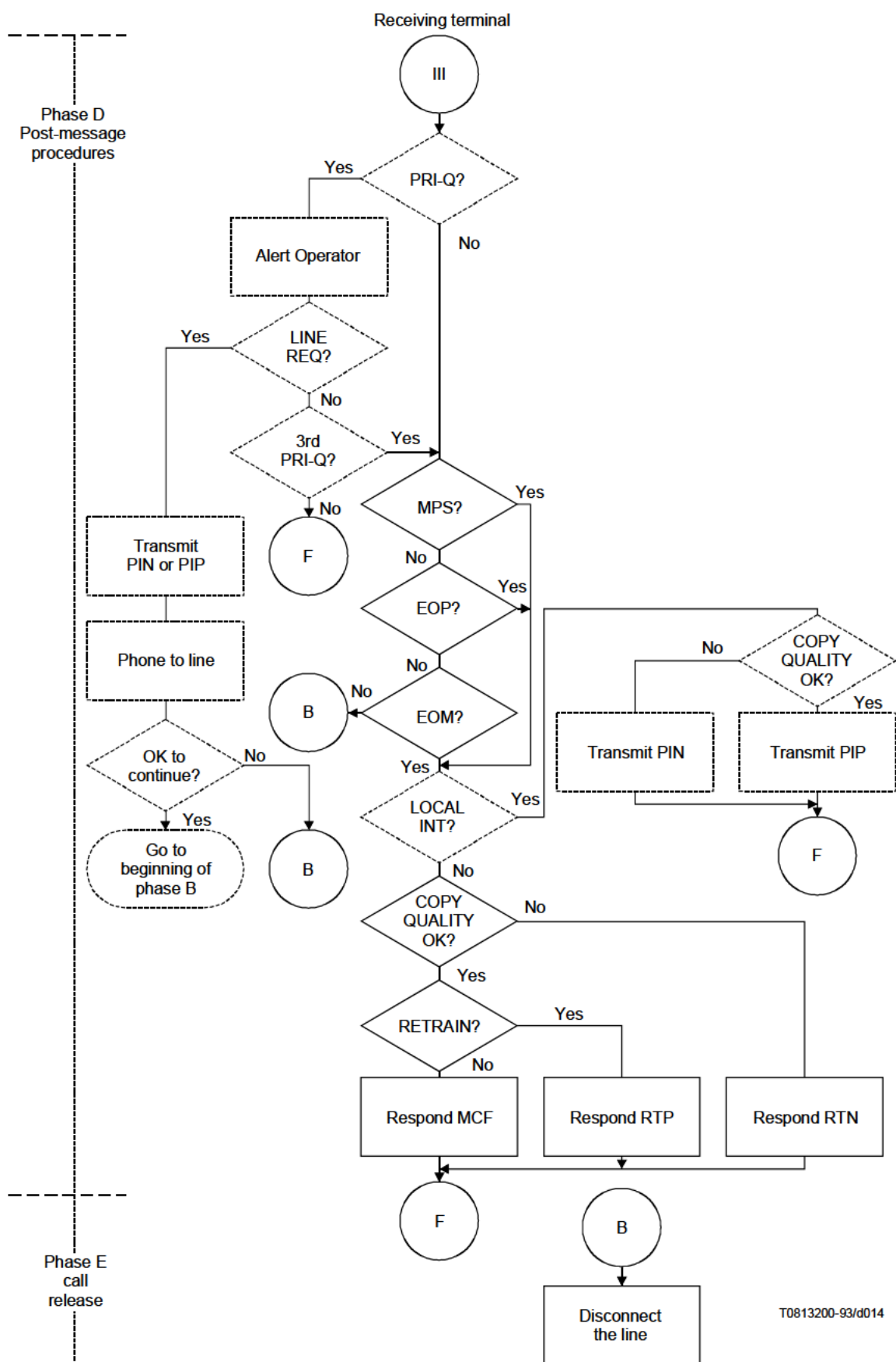
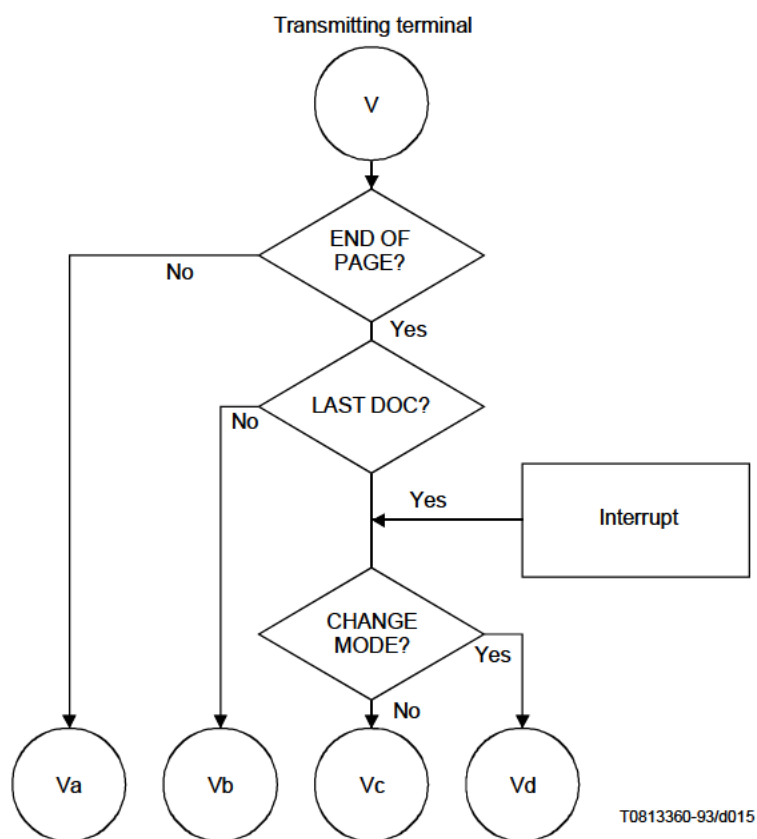


Figure 5-2d/T.30

**Figure 5-2e/T.30**

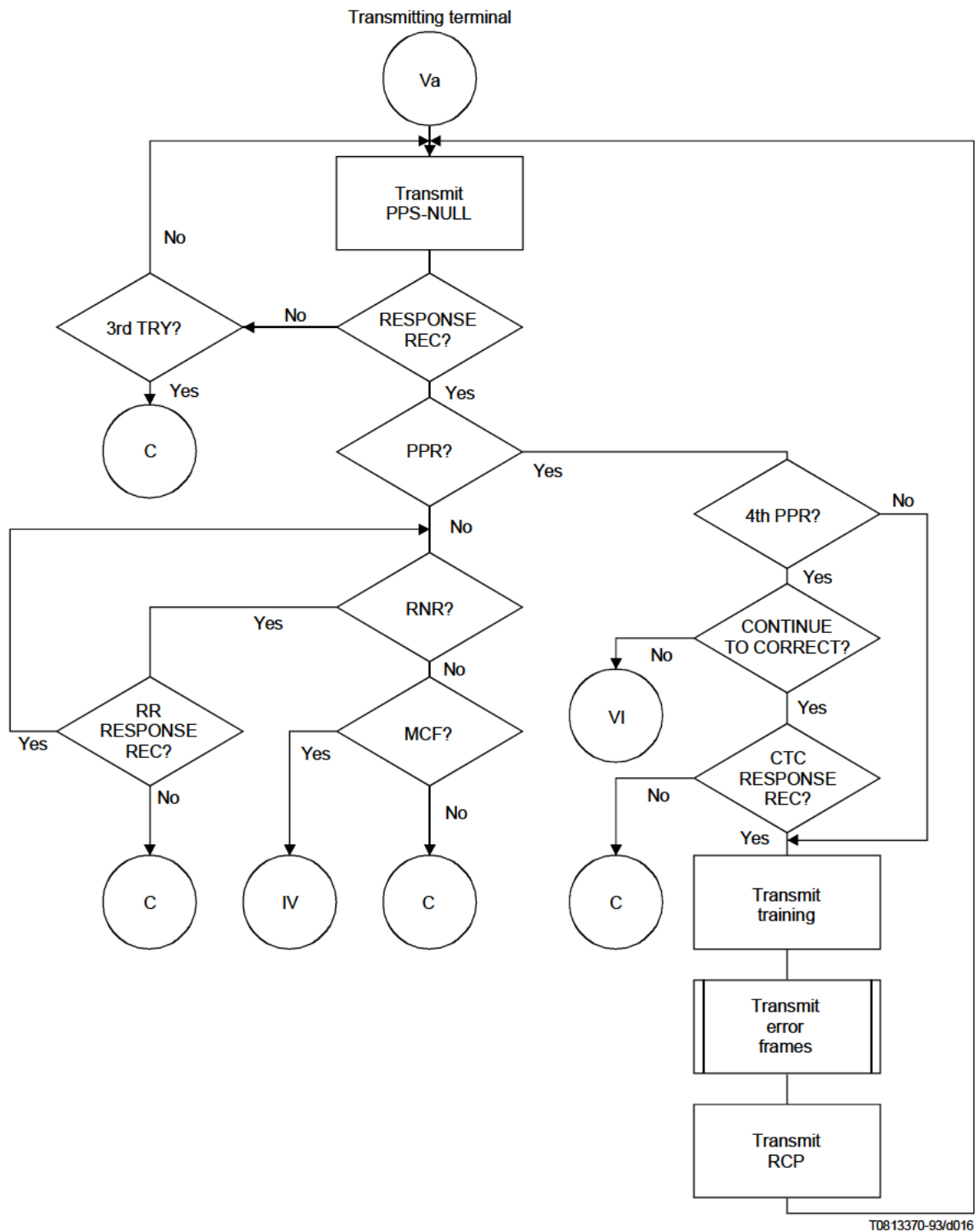


Figure 5-2f/T.30

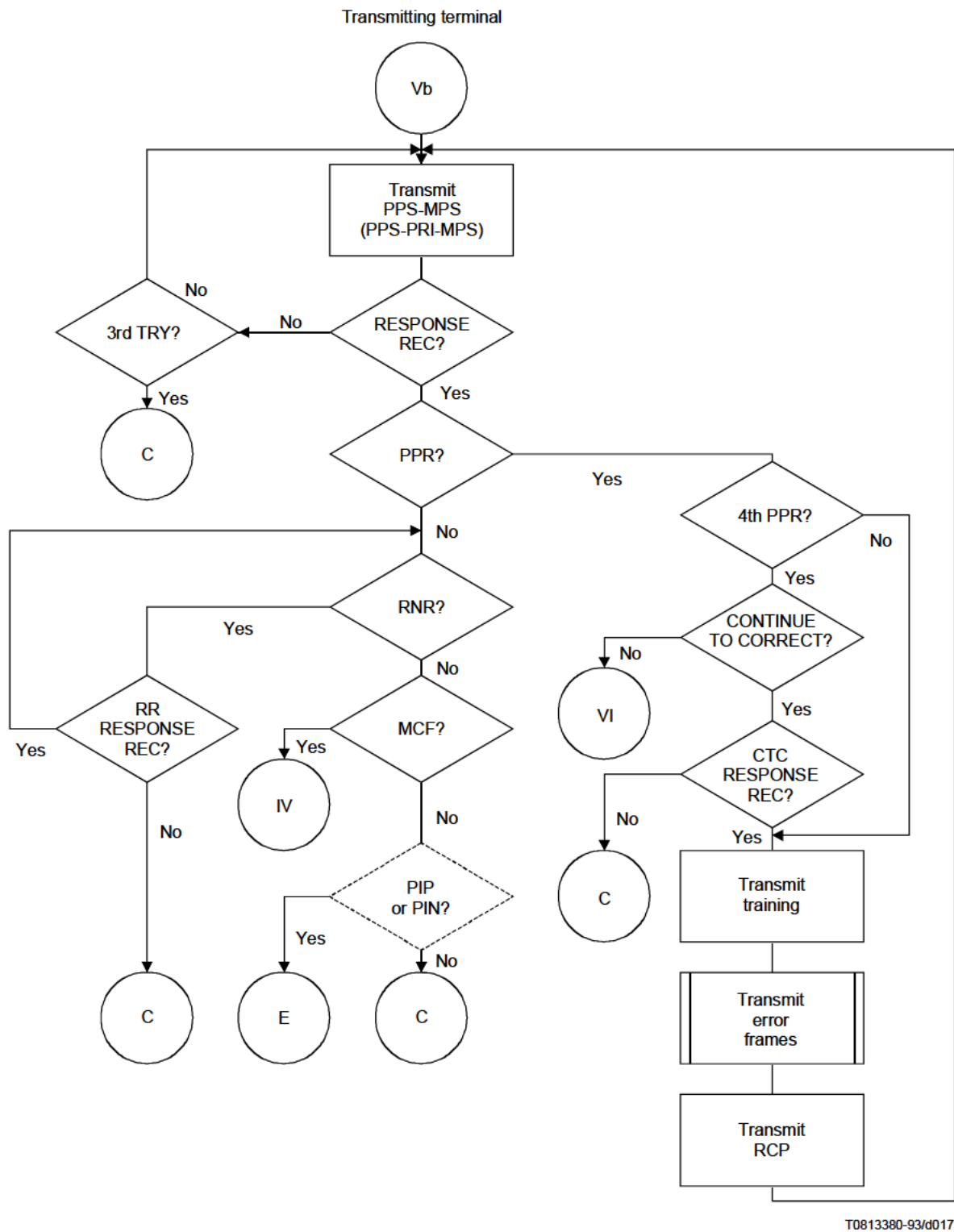


Figure 5-2g/T.30

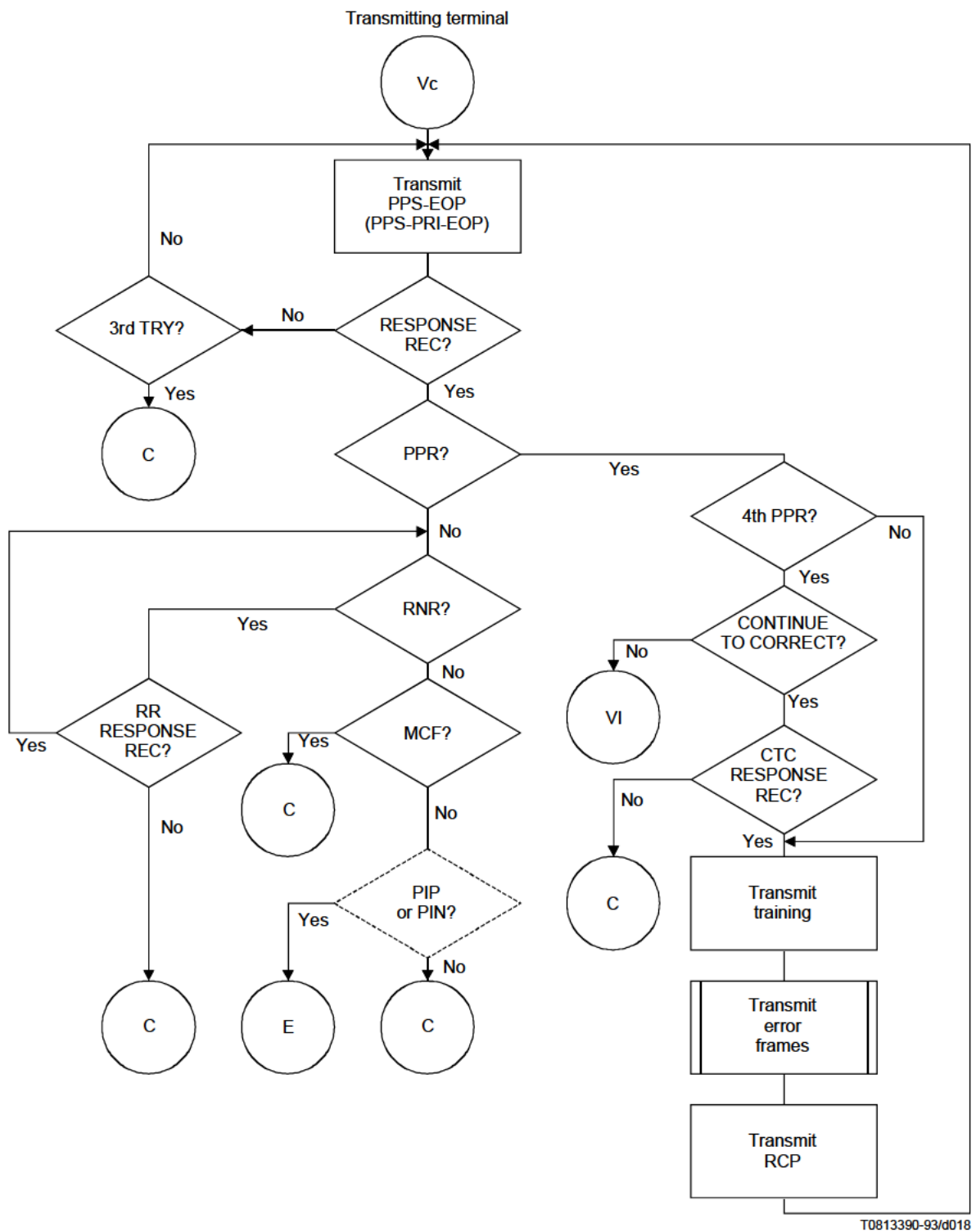


Figure 5-2h/T.30

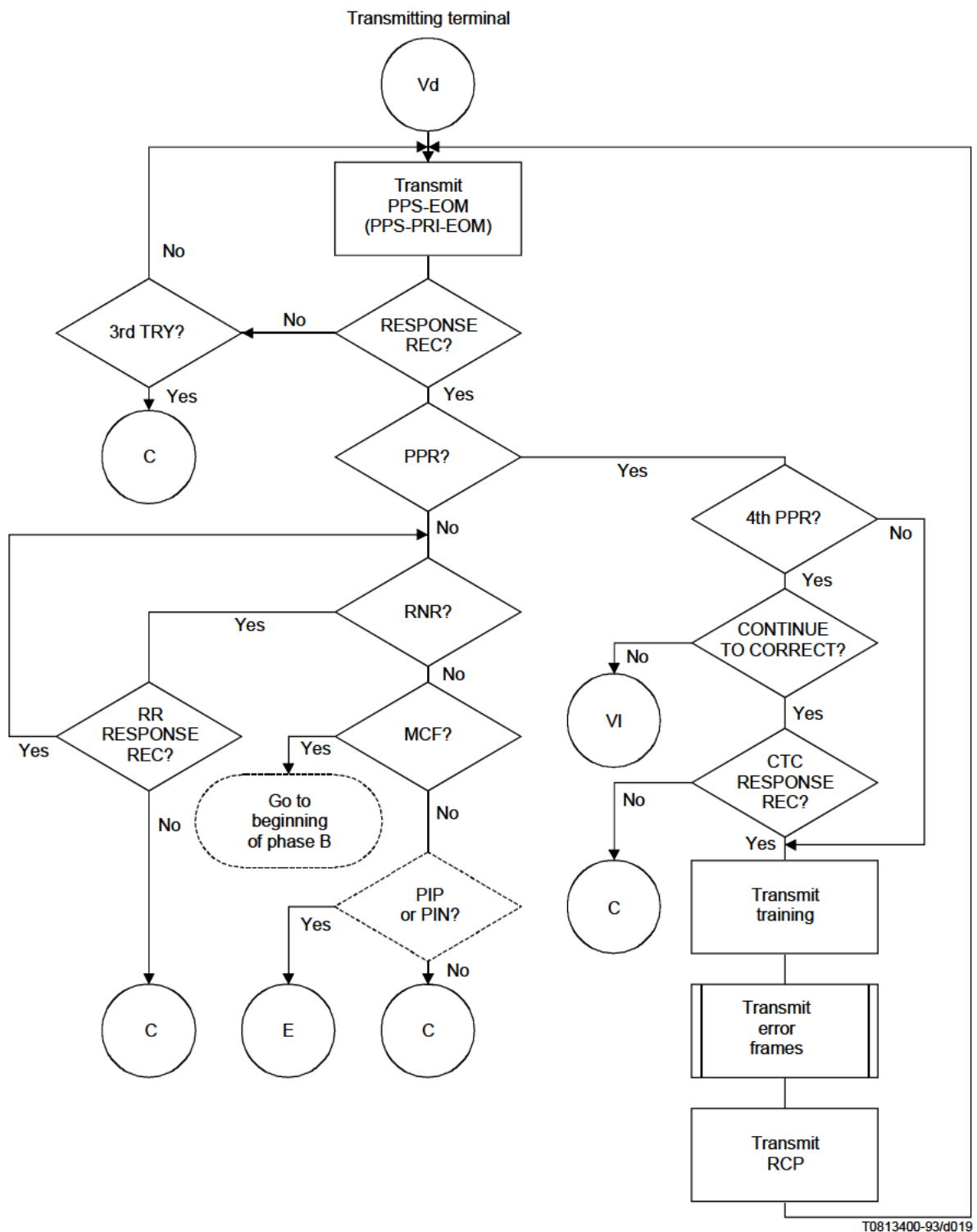
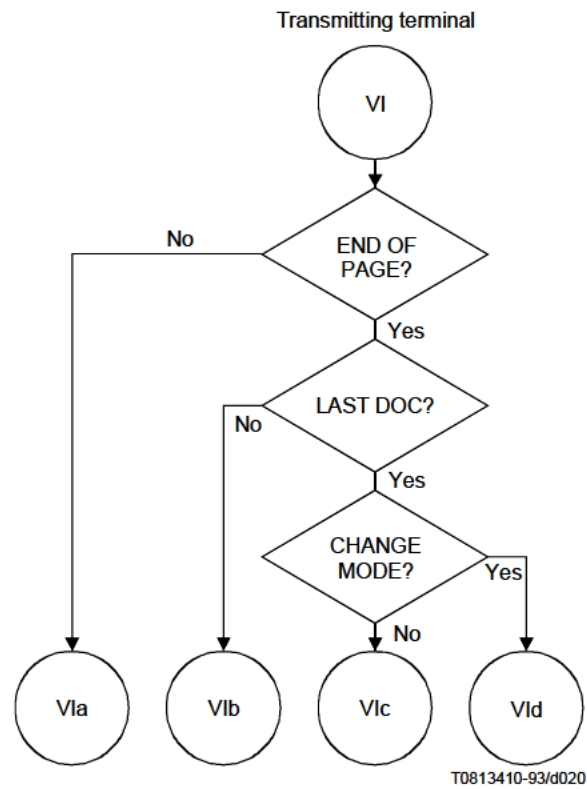


Figure 5-2i/T.30

**Figure 5-2j/T.30**

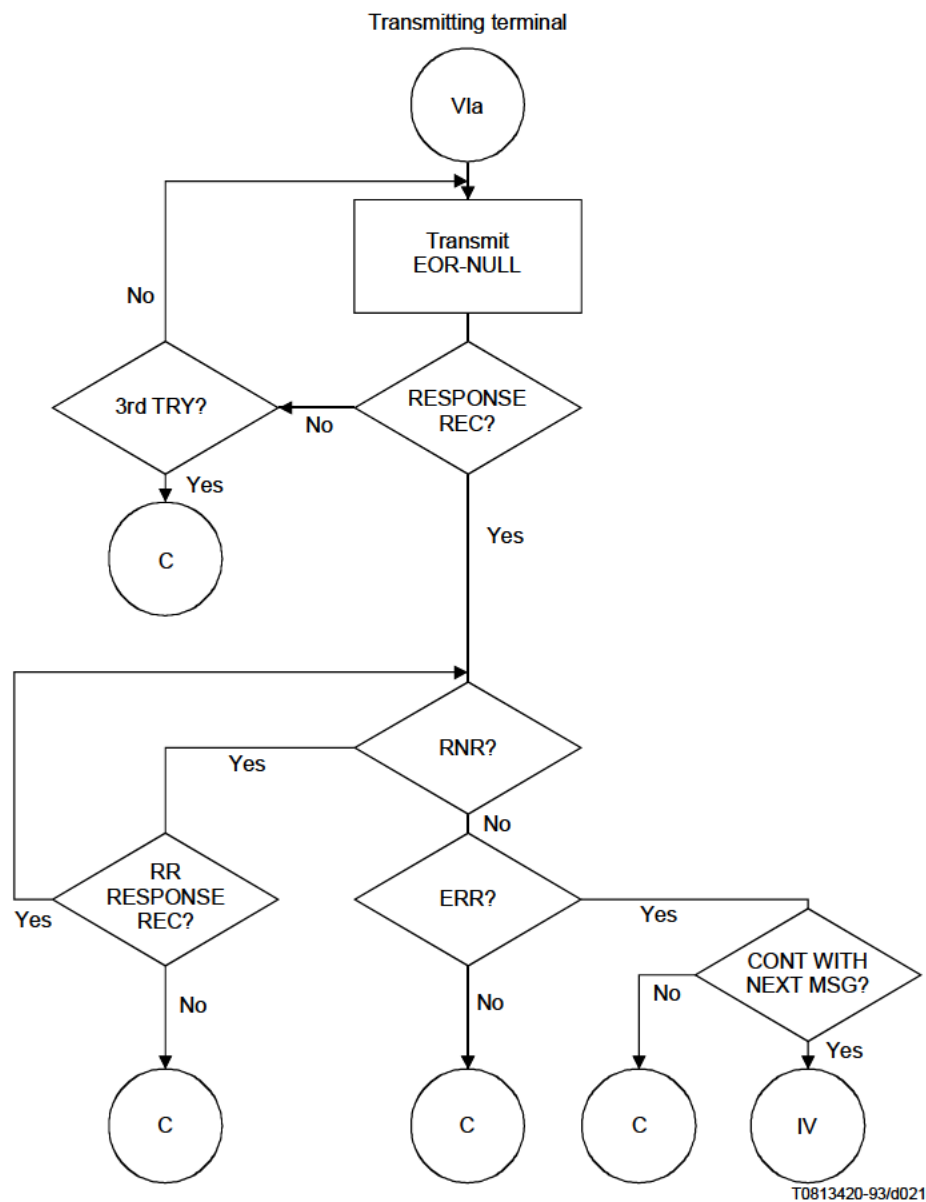


Figure 5-2k/T.30

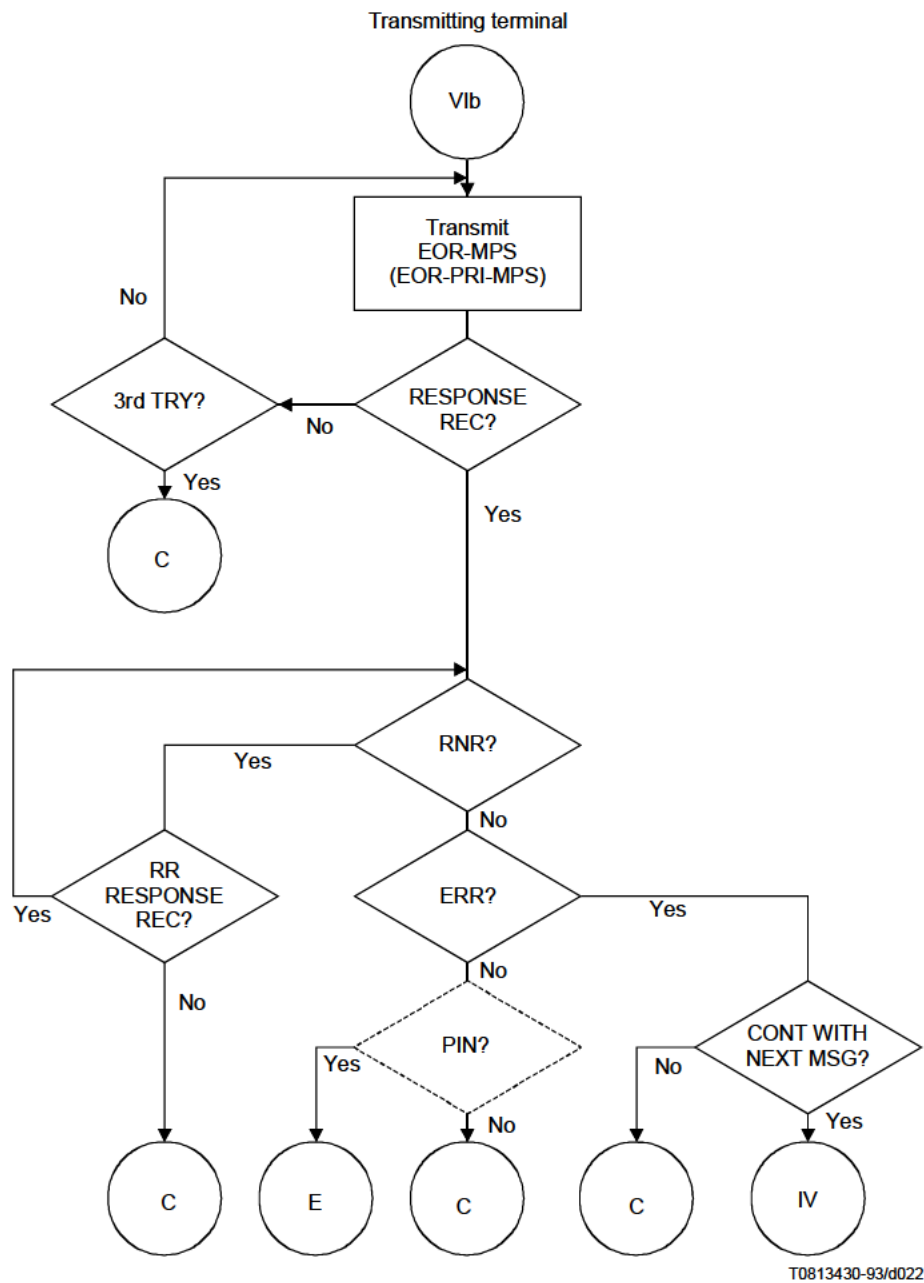


Figure 5-21/T.30

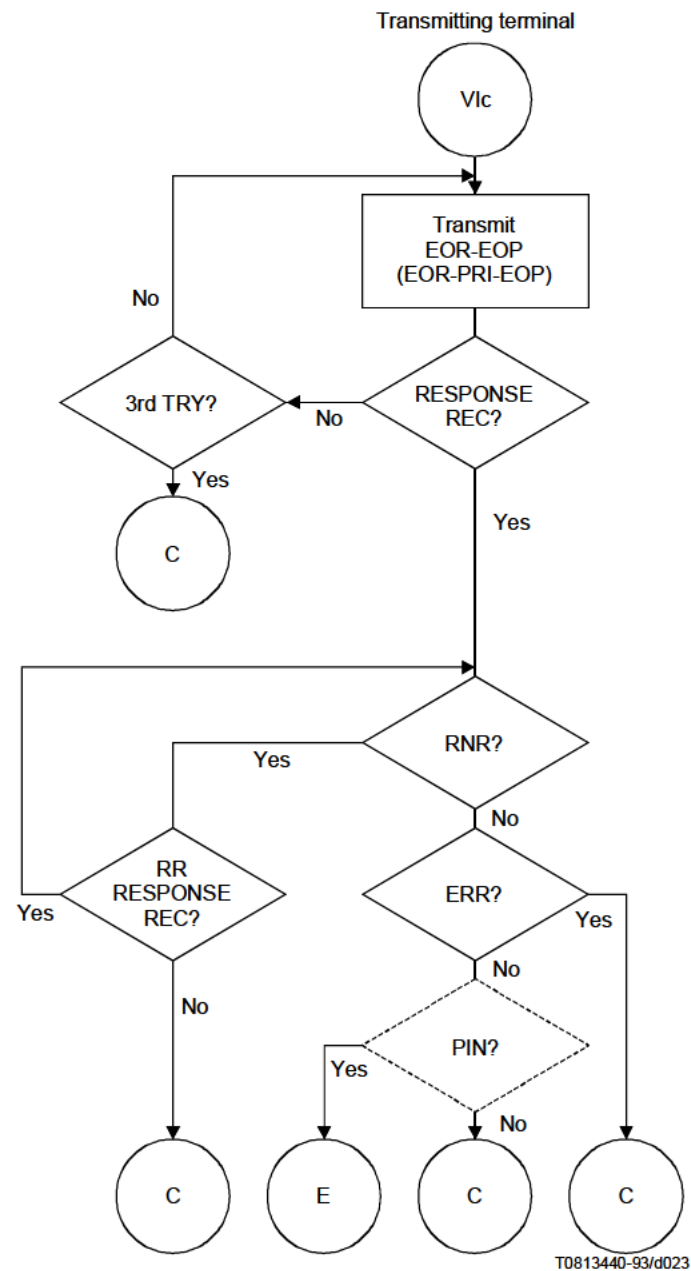


Figure 5-2m/T.30

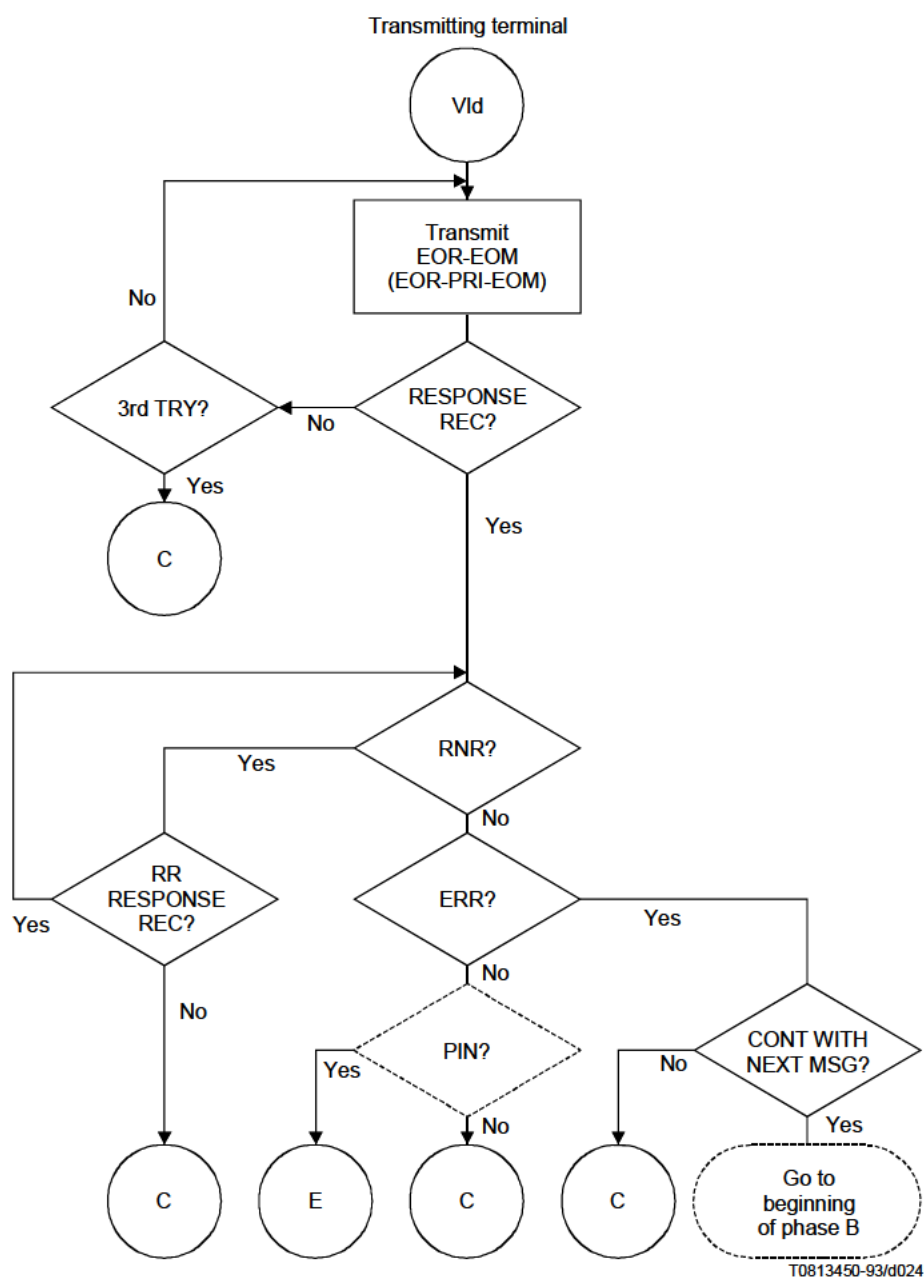


Figure 5-2n/T.30

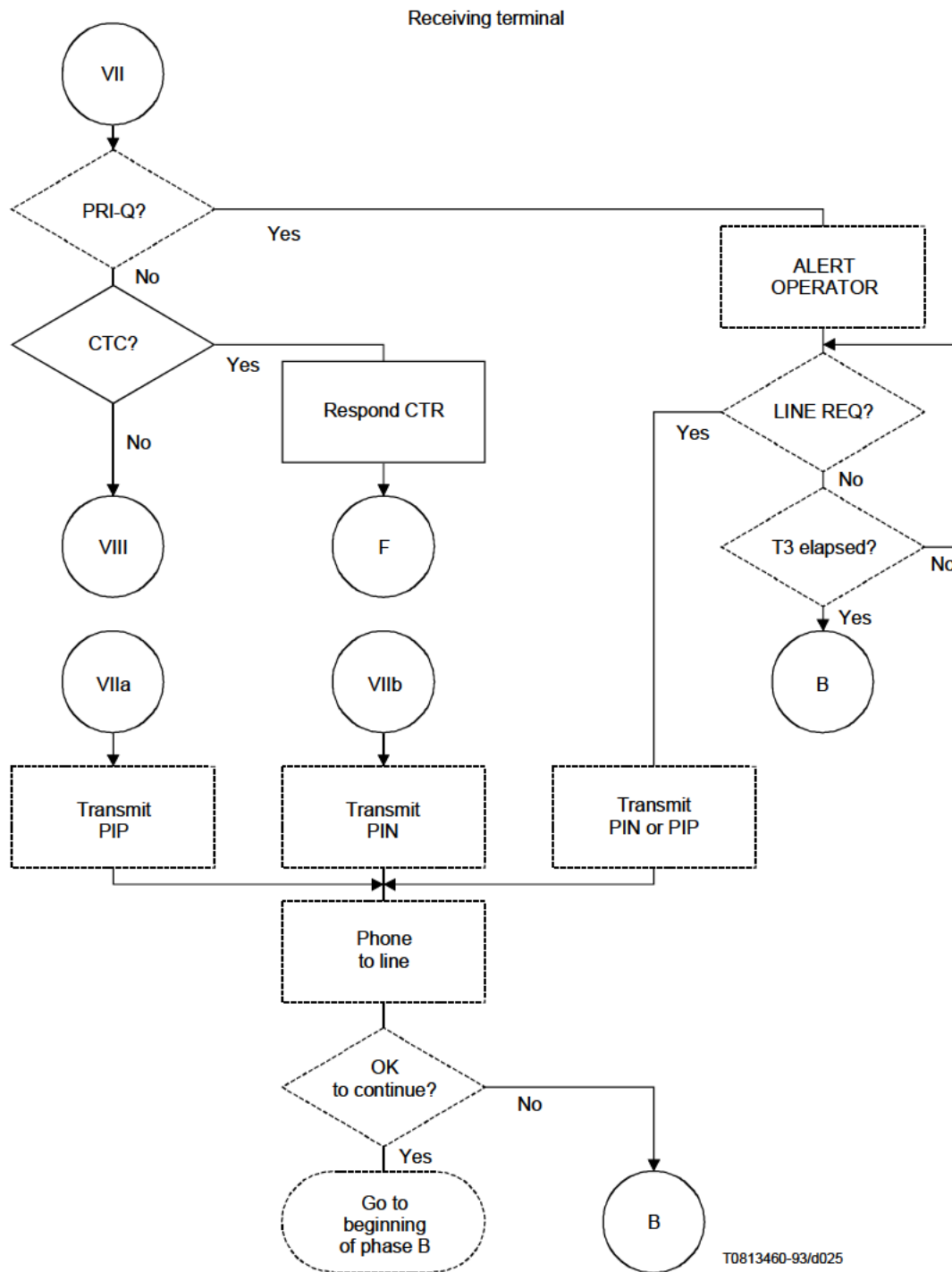


Figure 5-2o/T.30

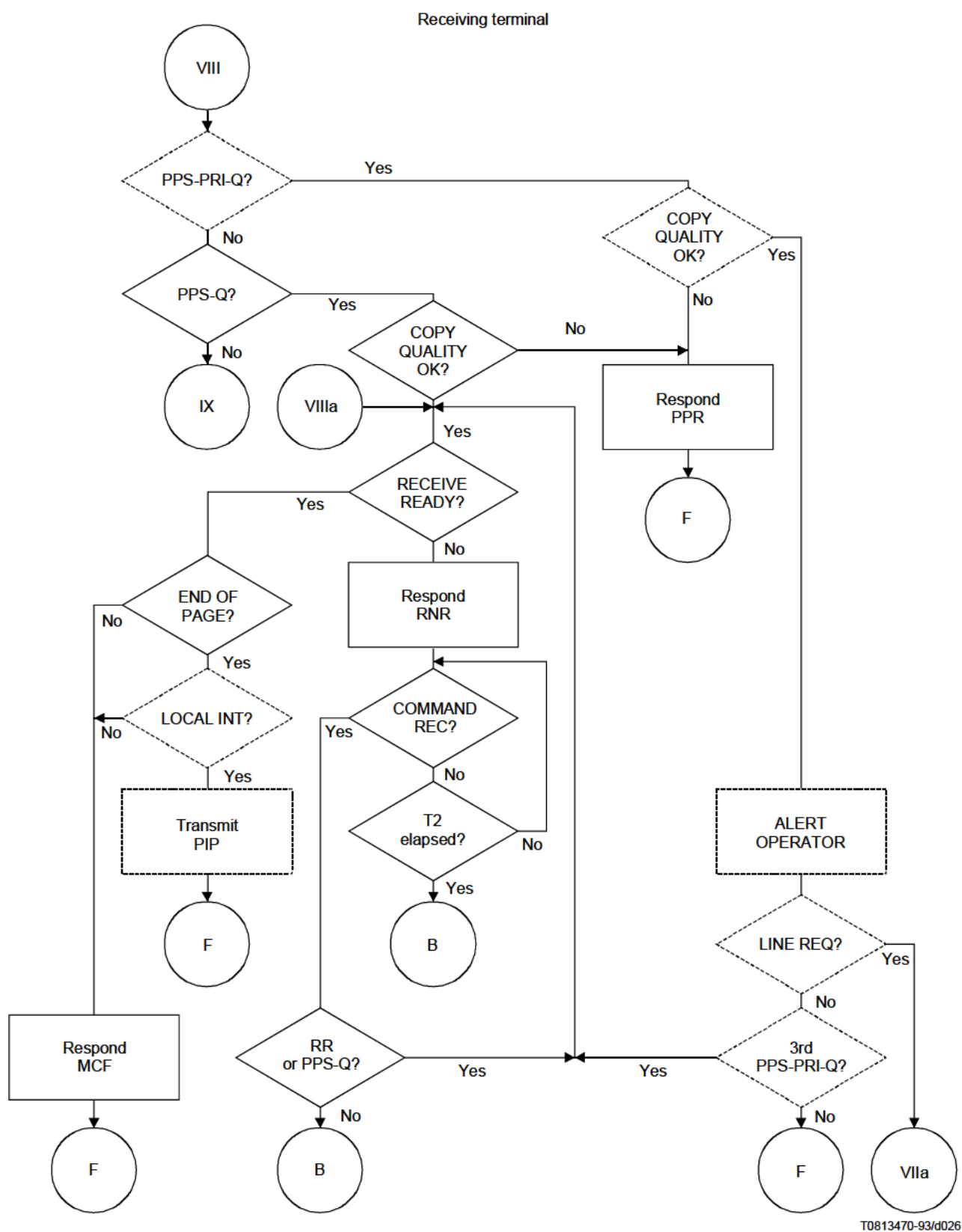


Figure 5-2p/T.30

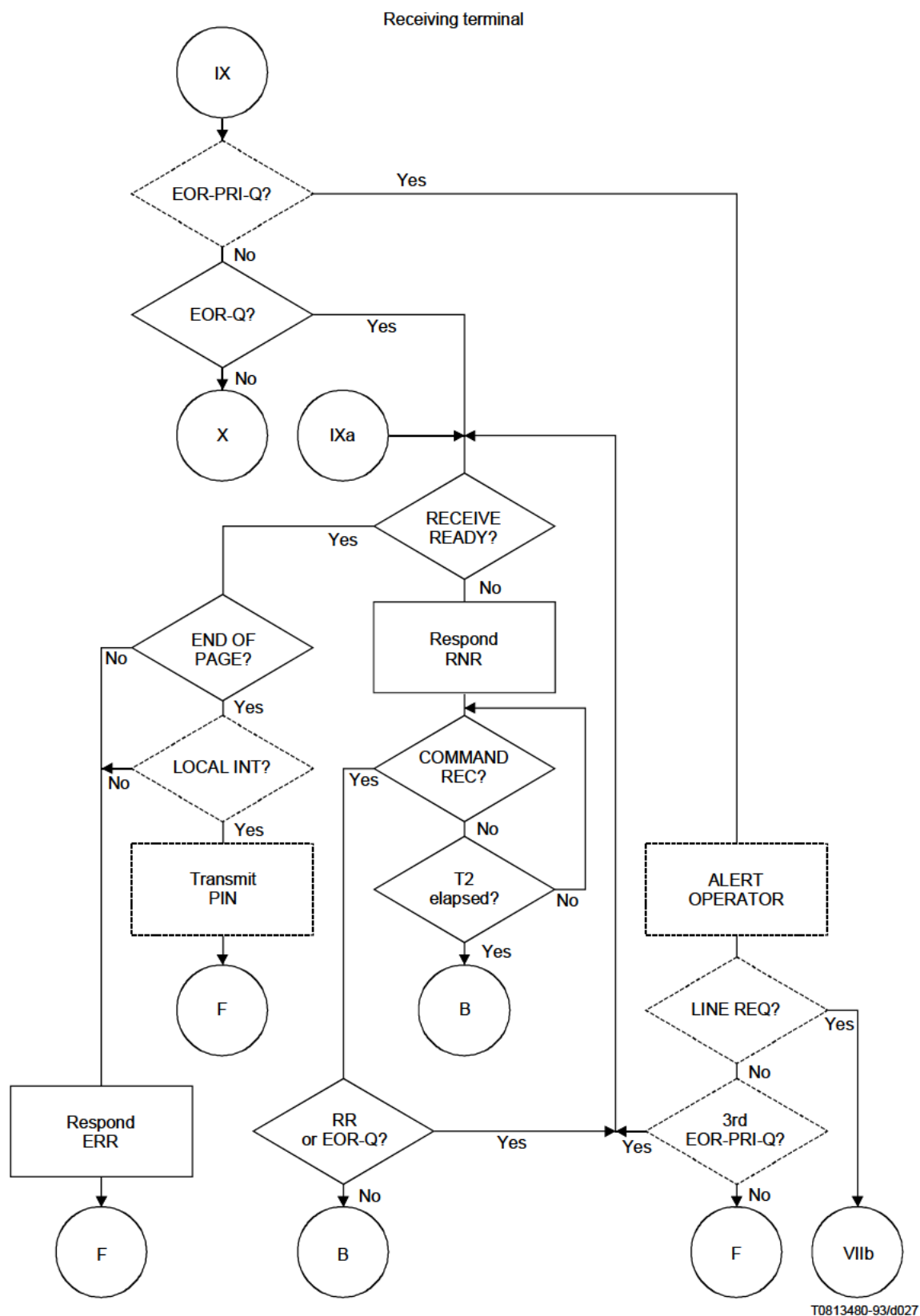


Figure 5-2q/T.30

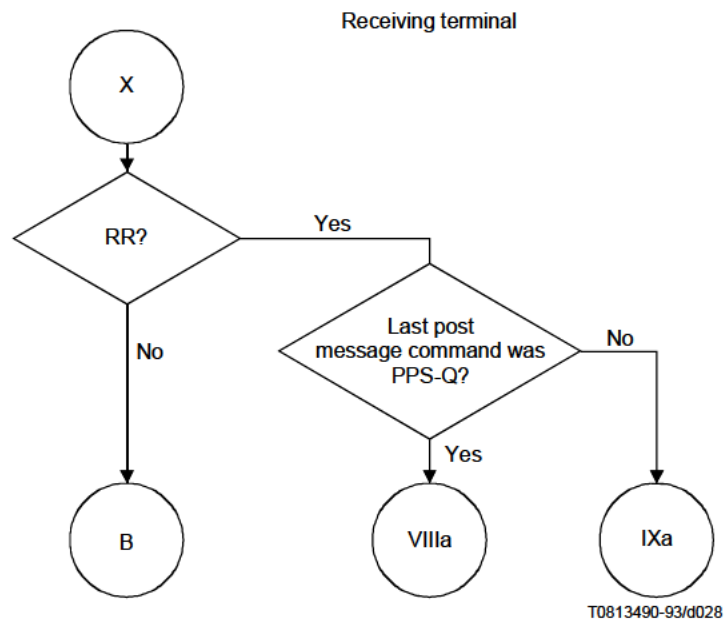
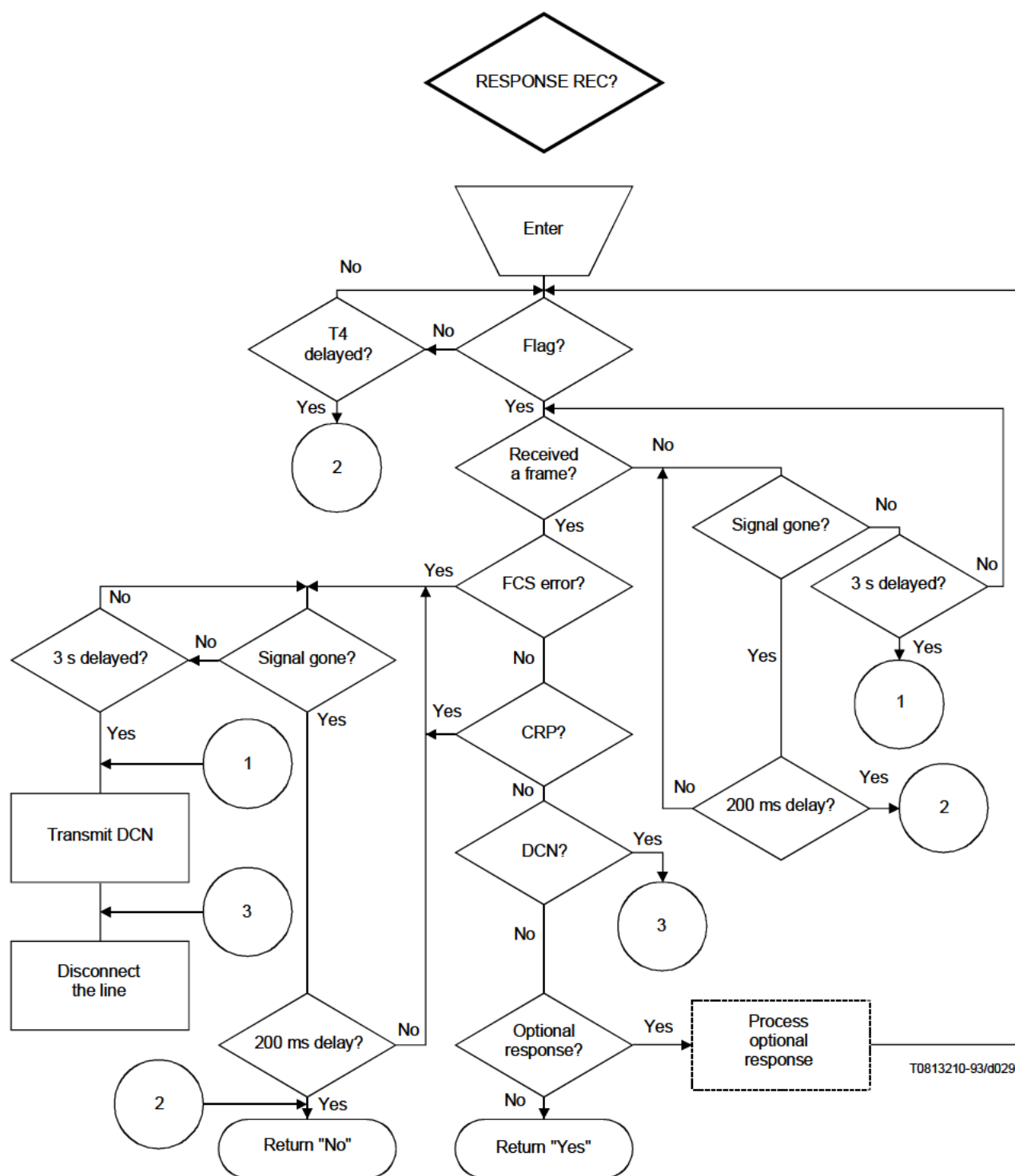


Figure 5-2r/T.30



NOTE – For manual units, the value of timer T4 may be either $3.0\text{ s} \pm 15\%$ or $4.5\text{ s} \pm 15\%$. If the value of 4.5 s is used, then after detection of a valid response to the first DIS, it may be reduced to $3.0\text{ s} \pm 15\%$. $T4 = 3.0\text{ s} \pm 15\%$ for automatic units.

Figure 5-2s/T.30

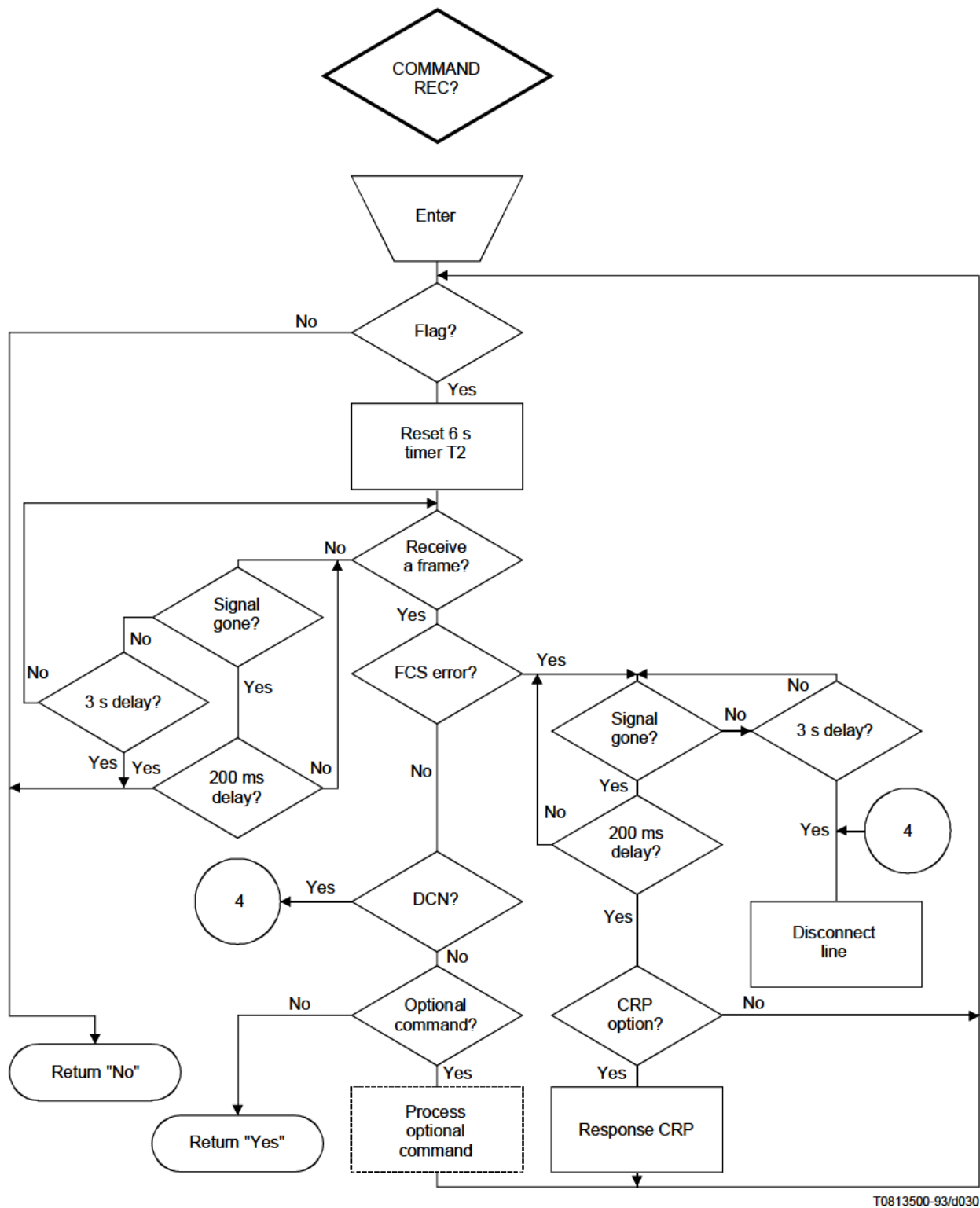


Figure 5-2t/T.30

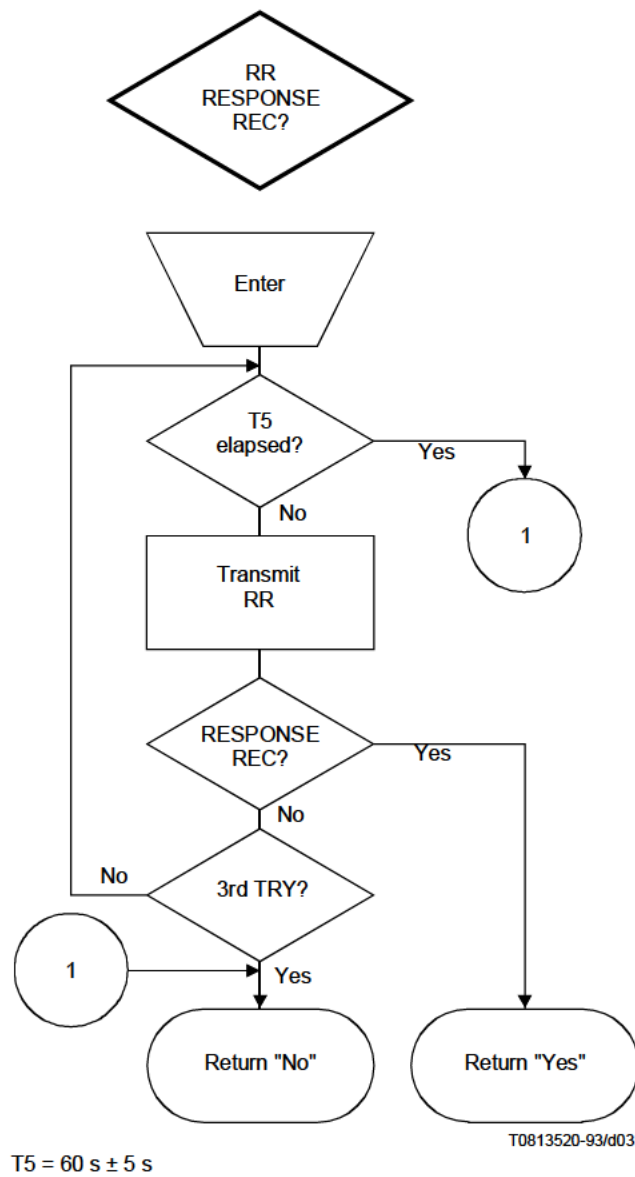
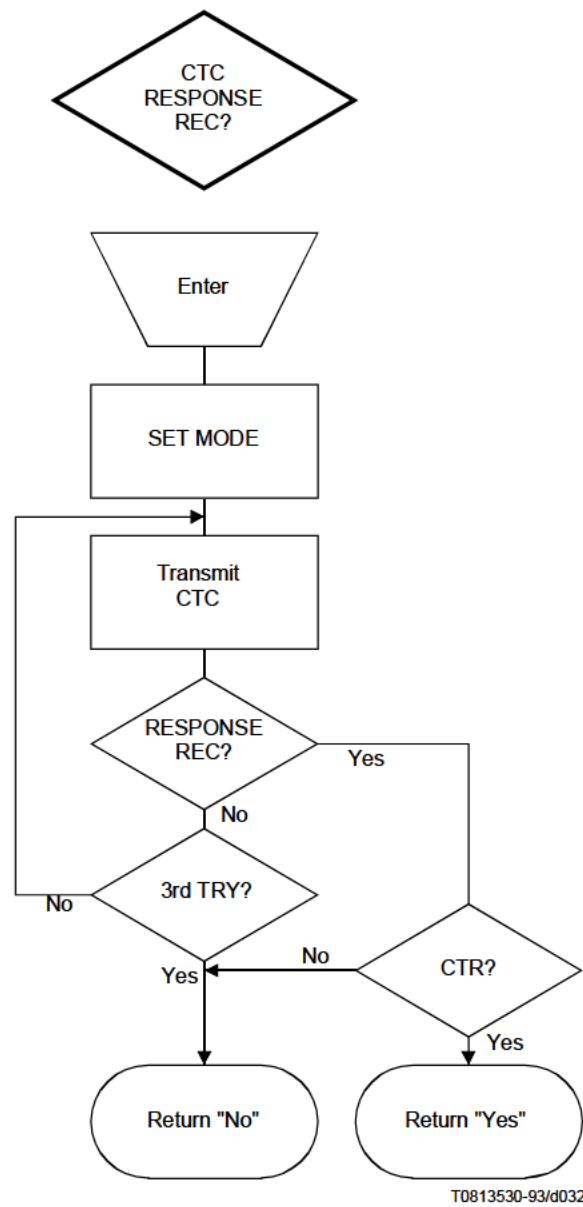


Figure 5-2u/T.30

**Figure 5-2v/T.30**

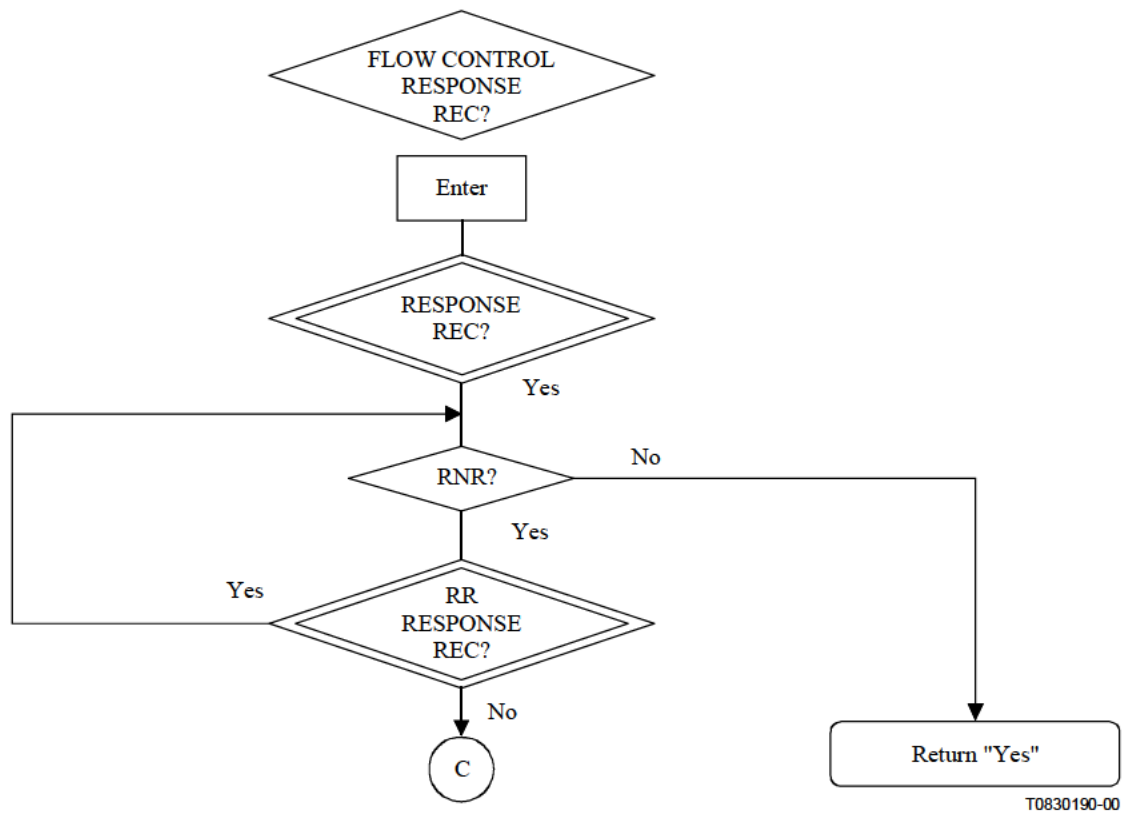
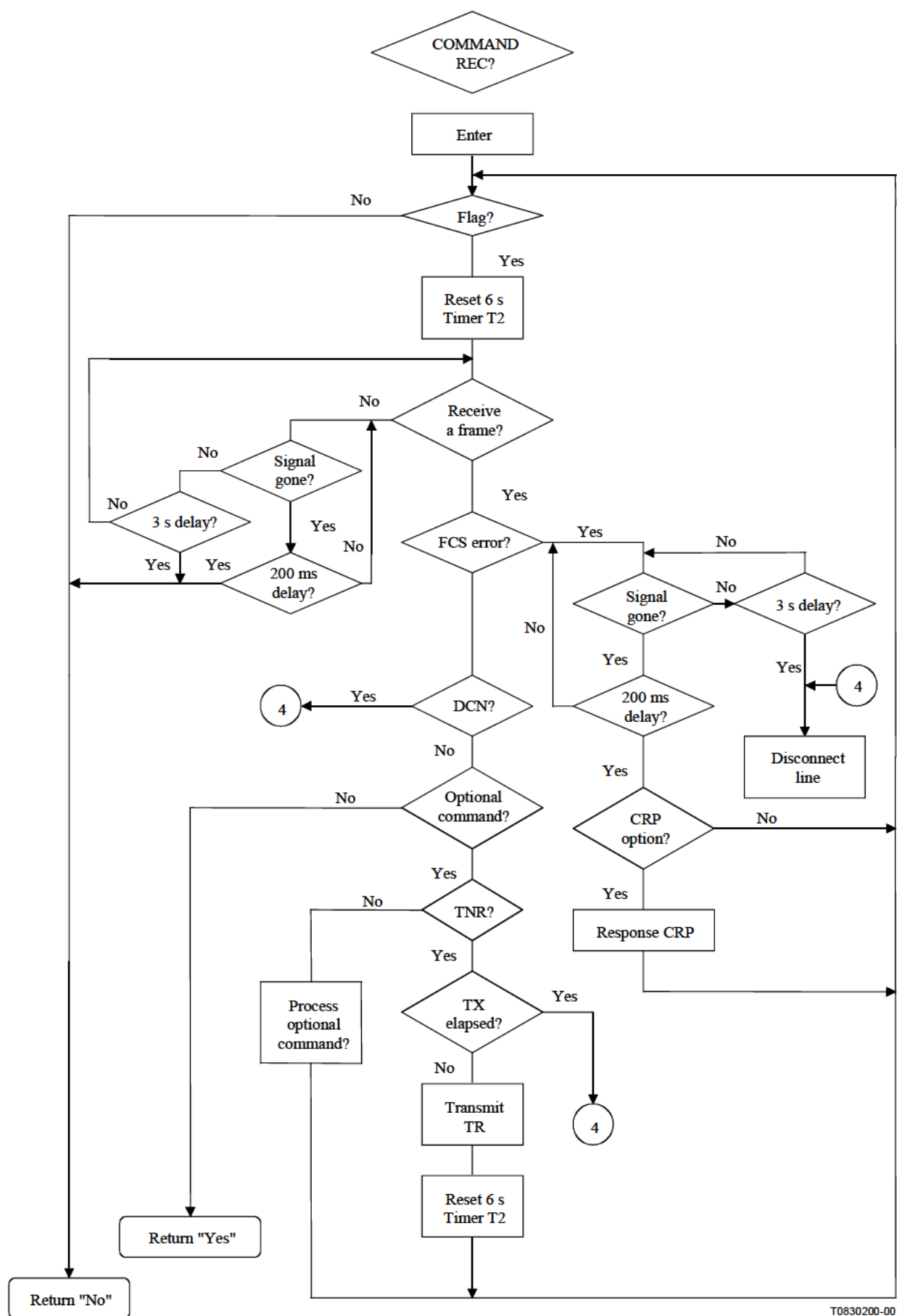


Figure 5-2w/T.30 – Response received in the optional flow control mode



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Figure 5-2x/T.30 – Command receive in optional flow control mode

5.2.1 Flow diagram key

COMMAND REC	The "command received" subroutine searches for an error-free standard command. The decision diamonds in the flow diagram refer to the most recent standard command received (e.g., EOM, MPS, etc.).
COMPT REMOTE REC	The FIF associated with the DIS has indicated a REC "compatible remote receiver".
DOC TO XMIT	The terminal has "at least one document to be transmitted".
COMPT REMOTE XMTR	The FIF associated with the DIS has indicated a "compatible remote transmitter" which has documents to send.
RESPONSE REC	The "response received" subroutine which searches for an error-free standard response.
LAST DOC	The "last document", for the given operating mode, has been transmitted.
SET MODE	The system controller will "set the appropriate mode" of operation.
3rd TRY	The command has been repeated three times without an appropriate response.
CAPABLE RE-XMIT	The transmitting terminal is "capable of retransmitting" a document which was not received with acceptable quality.
MSG CARRIER REC	The "message channel carrier has been received". This carrier is 1 800 Hz for the basic Group 3 modulation scheme. For details of the optional modulation schemes, refer to the relevant V-series Recommendations.
TRAIN OK	The training TCF signal has been analysed and the results of "training were OK".
CHANGE MODE	The transmitting terminal desires to exit from the transmitting mode of operation and re-establish the capabilities.
NSP REQ	A "non-specified procedure" has been "recognized" by a terminal compatible with the terminal initiating that procedure.
COPY QUALITY OK	By some algorithm, the "copy quality was deemed OK".
RETRAIN	By some algorithm, it is deemed desirable to transmit a new training signal.
FLAG	There has been the detection of a "flag".
RECEIVE A FRAME	The terminal has "received one complete HDLC frame".
FCS ERROR	The HDLC frame received contained an "FCS error".
OPTIONAL RESPNS	The HDLC frame received contained one of the listed "optional responses".
OPTIONAL COMMAND	The HDLC frame received contained one of the listed "optional commands".
CRP OPTION	The facsimile terminal has the "CRP option" and can, therefore, request an immediate retransmission of the most recent command.
LOCAL INT	Either the "local" terminal or the "local" operator wishes to generate an interrupt of the standard facsimile procedures. An operator would use this as a means to request the establishment of voice contact.

LINE REQ	This means that the local operator has "requested" that the telephone line be connected to the handset for voice contact with the remote end.
PRI-Q	A general term referring to either PRI-EOM, a PRI-MPS, or a PRI-EOP post-message command, i.e., the fifth bit of the standard post-message command is set to "1".
END OF PAGE?	The transmitting terminal may have further data to transmit to complete the page.
4th PPR?	PPR has been received 4 times.
TRANSMIT ERROR FRAMES	The frames defined in the information field associated with PPR are transmitted using the V.27 <i>ter</i> /V.29/V.17 modulation system.
CONTINUE TO CORRECT?	The transmitting terminal by some algorithm decides to continue correcting the previous message.
CONTINUE WITH NEXT MESSAGE?	The transmitting terminal by some algorithm decides to continue and transmit the next message. The previous message was not satisfactorily transmitted.
PPS-PRI-Q?	The terminal has "received either PPS-PRI-EOM, PPS-PRI-MPS or PPS, PRI-EOP post-message command".
PPS-Q?	The terminal has "received either PPS-EOM, PPS-MPS, PPS-EOP or PPS-NULL post-message command".
EOR-PRI-Q?	The terminal has "received either EOR-PRI-EOM, EOR-PRI-MPS or EOR-PRI-EOP post-message command".
EOR-Q?	The terminal has "received either EOR-EOM, EOR-MPS, EOR-EOP or EOR-NULL post-message command".
RECEIVE READY?	The receiving terminal is ready to receive the next message.
RR RESPONSE REC?	The "RR response received" subroutine searches for an error-free response for the RR command.
CTC RESPONSE REC?	The "CTC response received" subroutine searches for an error free response for the CTC command.

NOTE 1 – The non-specified procedure, NSP, refers to a procedure which takes 6 s or less to complete. It may not necessarily be a definable signal sequence.

NOTE 2 – The error correction mode is defined in Annex A.

NOTE 3 – The PRI-EOM, PRI-EOP, PRI-MPS post-message commands are sent when a local interrupt request is pending.

NOTE 4 – At any time during the operation an interrupt may be generated which would result in a procedural interrupt. It is understood that if this interrupt happens during the transmission of the document, the RTC/RCP signal will be transmitted prior to invoking the procedural interrupt.

NOTE 5 – Where the symbols { } are used, the signals within these symbols are a response to DIS from the calling terminal wishing to receive.

NOTE 6 – Where the symbols () are used, the signals within these symbols are optional.

NOTE 7 – Maximum number of tries is between 1 and 3.

5.3 Binary coded signal functions and formats

An HDLC frame structure is utilized for all binary coded facsimile control procedures. The basic HDLC structure consists of a number of frames, each of which is subdivided into a number of

fields. It provides for frame labelling, error checking and confirmation of correctly received information.

More specifically, the example in Figure 10 of a format is used for binary coded signalling. This example shows an initial identification sequence (see 5.3.6.1.1).

In the following descriptions of the fields, the order in which the bits are transmitted is from the most to the least significant bit, i.e., from left to right as printed. The exception to this is the CSI format (see 5.3.6.2.4).

The equivalent between binary notation symbols and the significant conditions of the signalling code should be in accordance with ITU-T Rec. V.1.

NOTE 1 – Any initial (capabilities identification) non-standard frame which is transmitted shall be accompanied by a mandatory frame. The mandatory frame shall always be the last one transmitted (see Figure 10).

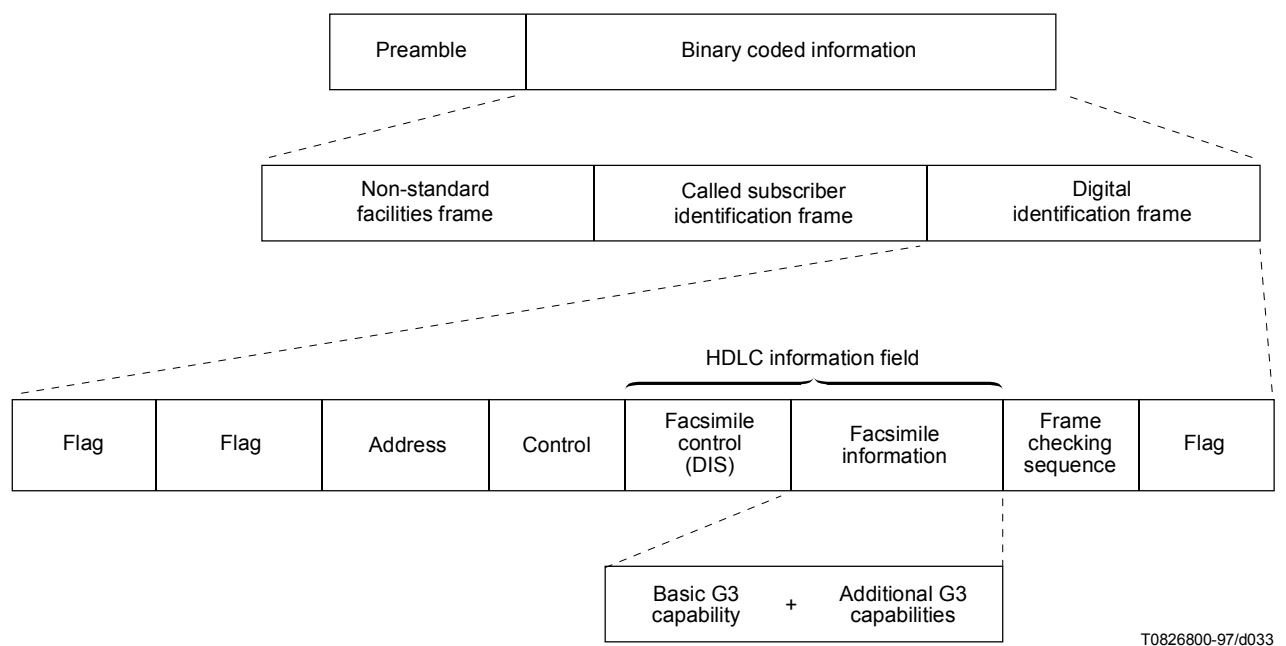
NOTE 2 – A terminal which receives optional frame(s) which it does not recognize shall discard the frame(s) and use the mandatory frames in continuing the procedure.

5.3.1 Preamble

The preamble shall precede all binary coded signalling whenever a new transmission of information begins in any direction (i.e., for each line turnaround). This preamble assures that all elements of the communication channel (e.g., echo suppressors) are properly conditioned so that the subsequent data may be passed unimpaired. This preamble shall be a series of flag sequences for $1\text{ s} \pm 15\%$.

NOTE – Some terminals which conform to the pre-1996 versions of this Recommendation may transmit an optional binary coded preamble at 2400 bit/s – see Appendix III.

5.3.2 Message/signalling delineation



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Figure 10/T.30

5.3.2.1 When the V.27 *ter*, V.29 or V.17 modulation scheme is employed, the delineation is obtained by the transmission of the RTC signal (see 4.1.4/T.4) and an RCP frame (see Annex A/T.4). This signals the T.4 modulation system to drop off the line and be replaced by the binary coded modulation system. When the V.34 modulation scheme is employed, the delineation is obtained as defined in Annex F.

NOTE – If the receiver detects at least one RCP frame correctly, it may initiate post-message command reception.

When operating in the duplex mode, the RCP frame is not used and delineation is obtained by use of the facsimile control field.

5.3.2.2 The transmission of the delineation signal, either the RTC signal or the RCP frame, shall be followed by a delay of 75 ± 20 ms before the binary coded modulation system commences to transmit.

5.3.2.3 After receipt of a signal using the binary coded modulation system, the transmitting terminal must wait at least 75 ms before sending any signals using V.27 *ter*/V.29/V.17 modulation system.

5.3.3 Flag sequence

The eight-bit HDLC flag sequence is used to denote the beginning and end of the frame. For the facsimile procedure, the flag sequence is used to establish bit and frame synchronization. The trailing flag of one frame may be the leading flag of the following frame.

Continued transmission of the flag sequence may be used to signal to the distant terminal that the terminal remains on line but is not presently prepared to proceed with the facsimile procedure.

Format: 0111 1110

5.3.4 Address field

The eight-bit HDLC address field is intended to provide identification of specific terminal(s) in a multipoint arrangement. In the case of transmission on the general switched telephone network, this field is limited to a single format.

Format: 1111 1111

5.3.5 Control field

The eight-bit HDLC control field provides the capability of encoding the commands and responses unique to the facsimile control procedures.

Format: 1100 X000

X = 0 for non-final frames within the procedure, X = 1 for final frames within the procedure. A final frame is defined as the last frame transmitted prior to an expected response from the distant terminal.

5.3.6 Information field

The HDLC information field is of variable length and contains specific information for the control and message interchange between two facsimile terminals. In this Recommendation it is divided into two parts, the Facsimile Control Field (FCF) and the Facsimile Information Field (FIF).

5.3.6.1 Facsimile Control Field (FCF)

The facsimile control field is defined to be the first 8 or 16 bits of the HDLC information field. An FCF of 16 bits should be applied only for the optional T.4 error correction mode. This field contains the complete information regarding the type of information being exchanged and the position in the overall sequence. The bit assignments within the FCF are as follows:

Where X appears as the first bit of FCF, X will be defined as follows:

- X is set to "1" by the terminal which receives a valid DIS signal;
- X is set to "0" by the terminal which receives a valid and appropriate response to a DIS signal;
- X will remain unchanged until the terminal again enters the beginning of phase B.

5.3.6.1.1 Initial identification

From the called to the calling terminal.

Format: 0000 XXXX

- 1) *Digital Identification Signal (DIS)* – Characterizes the standard ITU-T capabilities of the called terminal.

Format: 0000 0001

- 2) *Called Subscriber Identification (CSI)* – This optional signal may be used to provide the specific identity of the called subscriber by its international telephone number (see 5.3.6.2.4, CSI coding format).

Format: 0000 0010

- 3) *Non-Standard Facilities (NSF)* – This optional signal may be used to identify specific user requirements which are not covered by the T-series Recommendations.

Format: 0000 0100

5.3.6.1.2 Command to send

From a calling terminal wishing to be a receiver to a called terminal which is capable of transmitting.

Format: 1000 XXXX

- 1) *Digital Transmit Command (DTC)* – The digital command response to the standard capabilities identified by the DIS signal.

Format: 1000 0001

- 2) *Calling Subscriber Identification (CIG)* – This optional signal indicates that the following FIF information is an identification of that calling terminal. It may be used to provide additional security to the facsimile procedure (see 5.3.6.2.5, CIG coding format).

Format: 1000 0010

- 3) *Non-Standard facilities Command (NSC)* – This optional signal is the digital command response to the information contained in the NSF signal.

Format: 1000 0100

- 4) *Password (PWD)* – This optional signal indicates that the following FIF information is a password for the polling mode. It may be used to provide additional security to the facsimile procedure (see 5.3.6.2.8, PWD coding format). PWD is only sent if bit 50 in DIS is set. This signal shall only be used once in each signal sequence i.e., concatenated signals are not permitted.

Format: 1000 0011

- 5) *Selective Polling (SEP)* – This optional signal indicates that the following FIF information is:

- a) a subaddress for the polling mode; or
- b) a specific document number.

(See 5.3.6.2.9, SEP coding format.) SEP is only sent if bit 47 in DIS is set. This signal shall only be used once in each signal sequence, i.e., concatenated signals are not permitted.

Format: 1000 0101

NOTE – When PSA and SEP are used together in the polling mode, option b) is applied.

- 6) *Polled Subaddress (PSA)* – This optional signal indicates that the following FIF information is a subaddress for polling (see 5.3.6.2.14, PSA coding format). PSA is only sent if bit 35 in the DIS is set. This signal shall only be used once in each signal sequence, i.e., concatenated signals are not permitted.

Format: 1000 0110

- 7) *Calling subscriber Internet Address (CIA)* – This optional signal indicates that the following FIF information is an address in the Internet of that calling station (see 5.3.6.2.12, CSA, TSA, CIA, IRA and ISP coding format). CIA is sent with DTC only when Internet capabilities (Bit 1 or 3) in DIS is set. Sending multiple Internet address is for further study.

Format: 1000 0111

- 8) *Internet Selective Polling Address (ISP)* – This optional signal indicates that the following FIF information is an address in the Internet for the polling mode. It may be used to indicate that a specific document shall be polled at the called gateway (see 5.3.6.2.12, CSA, TSA, CIA, IRA and ISP coding format). ISP is only sent if bit 101 in DIS is set. Sending multiple Internet address is for further study.

Format: 1000 1000

5.3.6.1.3 Command to receive

From the transmitter to the receiver.

Format: X100 XXXX

- 1) *Digital Command Signal (DCS)* – The digital set-up command responding to the standard capabilities identified by the DIS signal.

Format: X100 0001

- 2) *Transmitting Subscriber Identification (TSI)* – This optional signal indicates that the following FIF information is the identification of the transmitting terminal. It may be used to provide additional security to the facsimile procedures. (See 5.3.6.2.6, TSI coding format.)

Format: X100 0010

- 3) *Non-Standard facilities Set-up (NSS)* – This optional signal is the digital command response to the information contained in the NSC or NSF signal.

Format: X100 0100

- 4) *Subaddress (SUB)* – This optional signal indicates that the following FIF information is a subaddress in the called subscriber's domain. It may be used to provide additional routing information in the facsimile procedure (see 5.3.6.2.10, SUB coding format). SUB is only sent if bit 49 in DIS/DTC is set. This signal shall only be used once in each signal sequence, i.e., concatenated signals are not permitted.

Format: X100 0011

- 5) *Sender Identification (SID)* – This optional signal indicates that the following FIF information is the sender identity (see 5.3.6.2.11, SID coding format). SID is only sent if bit 50 in DIS is set. This signal shall only be used once in each signal sequence, i.e., concatenated signals are not permitted.

Format: X100 0101

- 6) *Training Check (TCF)* – This digital command is sent through the T.4 modulation system to verify training and to give a first indication of the acceptability of the channel for this data rate.

Format: A series of 0 for $1.5\text{ s} \pm 10\%$.

NOTE – No HDLC frame is required for this command.

- 7) *Continue To Correct (CTC)* – This digital command is only used in the optional T.4 error correction mode. See item 1) of A.4.1.

- 8) *Transmitting Subscriber Internet address (TSA)* – This optional signal indicates that the following FIF information is an address in the Internet of that transmitting station (see 5.3.6.2.12, CSA, TSA, CIA, IRA and ISP coding format). TSA is sent with DCS only when Internet capabilities (Bit 1 or 3) in DIS is set to 1. Sending multiple Internet address is for further study.

Format: X100 0110

- 9) *Internet Routing Address (IRA)* – This optional signal indicates that the following FIF information is an address in the Internet. It may be used to provide additional routing information for gateways in the facsimile procedure (see 5.3.6.2.12, CSA, TSA, CIA, IRA and ISP coding format). IRA is only sent if bit 102 in DIS/DTC is set. Sending multiple Internet address is for further study.

Format: X100 0111

5.3.6.1.4 Pre-message response signals

From the receiver to the transmitter.

Format: X010 XXXX

- 1) *Confirmation To Receive (CFR)* – A digital response confirming that the entire pre-message procedure has been completed and the message transmissions may commence.

Format: X010 0001

- 2) *Failure To Train (FTT)* – A digital response rejecting the training signal and requesting a retrain.

Format: X010 0010

- 3) *Response for Continue To Correct (CTR)* – This digital response is only used in the optional T.4 error correction mode. For further details, refer to item 1) of A.4.2.

- 4) *Called Subscriber Internet Address (CSA)* – This optional signal indicates that the following FIF information is an address in the Internet of that called station (see 5.3.6.2.12, CSA, TSA, CIA, IRA and ISP coding format). CSA is sent with CFR only when Internet capabilities (Bit 1 or 3) in DCS is set to 1. Sending multiple Internet address is for further study.

Format: X010 0100

NOTE 1 – Transmitter will send message when CFR or CSA/CFR is detected.

NOTE 2 – Transmitter will send message, but will not request retransmission of CSA, when CFR is detected but CSA is not detected.

NOTE 3 – Transmitter will request retransmission of CFR when only CSA is detected.

5.3.6.1.5 In-message procedure

From the transmitter to the receiver. The in-message procedure formats and specific signals shall be consistent with ITU-T Rec. T.4.

5.3.6.1.6 Post-message commands

From the transmitter to the receiver.

Format: X111 XXXX

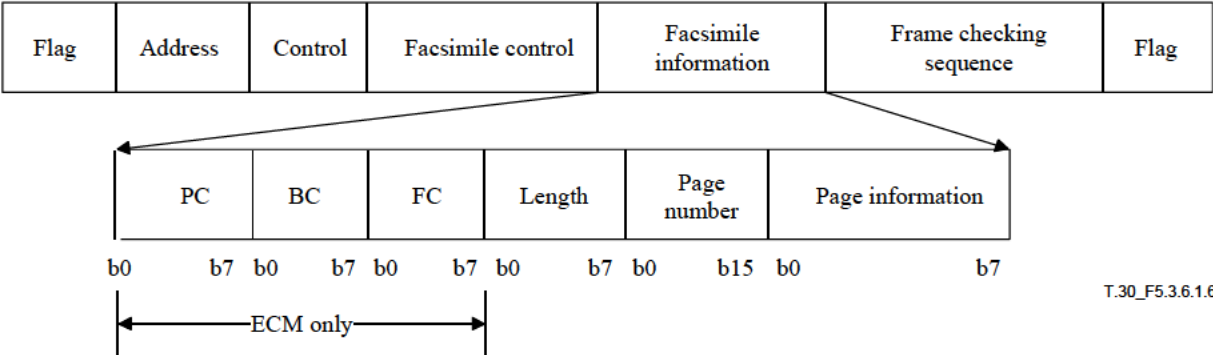
- 1) *End Of Message (EOM)* – To indicate the end of a complete page of facsimile information and to return to the beginning of phase B.
Format: X111 0001
- 2) *MultiPage Signal (MPS)* – To indicate the end of a complete page of facsimile information and to return to the beginning of phase C upon receipt of a confirmation.
Format: X111 0010
- 3) *End Of Procedure (EOP)* – To indicate the end of a complete page of facsimile information and to further indicate that no further documents are forthcoming and to proceed to phase E, upon receipt of a confirmation.
Format: X111 0100
- 4) *Procedure Interrupt-End Of Message (PRI-EOM)* – To indicate the same as an EOM command with the additional optional capability of requesting operator intervention. If operator intervention is accomplished, further facsimile procedures shall commence at the beginning of phase B.
Format: X111 1001
- 5) *Procedure Interrupt-MultiPage Signal (PRI-MPS)* – To indicate the same as an MPS command with the additional optional capability of requesting operator intervention. If operator intervention is accomplished, further facsimile procedures shall commence at the beginning of phase B.
Format: X111 1010
- 6) *Procedure Interrupt-End Of Procedure (PRI-EOP)* – To indicate the same as an EOP command with the additional optional capability of requesting operator intervention. If operator intervention is accomplished, further facsimile procedures shall commence at the beginning of phase B.
Format: X111 1100

NOTE 1 – Commands EOM, MPS, EOP, PRI-Q should not be used in the optional T.4 error correction mode.

NOTE 2 – In the duration between partial-pages, procedure interrupt signals should not be transmitted in the optional T.4 error correction mode.

- 7) *End Of Selection (EOS)* – This optional command from the multiple-SEP-capable polling transmitter to the SEP-capable polling receiver shall be used to indicate that the end (last page or last block) of the currently selected document has been reached and that a return to phase B is expected for the purpose of eliciting any new SEP-selected document request. EOS may only be transmitted if bit 34 was set in the receiver's DTC.
Format: X111 1000
- 8) *Partial Page Signal (PPS)* – This digital command is only used in the optional T.4 error correction mode. See item 1) of A.4.3.
- 9) *End Of Retransmission (EOR)* – This digital command is only used in the optional T.4 error correction mode. See item 2) of A.4.3.
- 10) *Receive ready (RR)* – This digital command is only used in the optional T.4 error correction mode or optional flow control mode. With respect to the optional T.4 error correction mode, see item 3) of A.4.3.

NOTE 3 – Post-message command coding format when applying double side mode is as follows:



One octet for length, two octets for page number and one octet for page information are required for Facsimile information. A page number shall start from 1. The example of the length is "03h" and page number is "06h" is as follows:

Length	Page number
1 1 0 0 0 0 0 0	0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0
b0b7	b0b15

The fourth octet is known as page information and the values which apply for this octet are shown in the table below. Bit 7 is an extended bit, which shall be set to "1" if there is additional page information octets

The receiving terminal shall receive unknown extended FIF data to keep the interoperability.

Bit No.	Page information
0	Page value 0: front side / 1: reverse side
1	Reserved
2	Reserved
3	Reserved
4	Reserved
5	Reserved
6	Reserved
7	Extend bit – default "0"

5.3.6.1.7 Post-message responses

From the receiver to the transmitter.

Format: X011 XXXX

- 1) *Message Confirmation (MCF)* – To indicate that a complete message has been satisfactorily received and that additional messages may follow. (This is a positive response to MPS, EOM, EOP, RR and PPS.)
Format: X011 0001
- 2) *Retrain Positive (RTP)* – To indicate that a complete message has been received and that additional messages may follow after retransmission of training and CFR.
Format: X011 0011

NOTE 1 – RTP is not applicable to the optional T.4 error correction mode.

- 3) *Retrain Negative (RTN)* – To indicate that the previous message has not been satisfactorily received. However, further receptions may be possible, provided training is retransmitted.

Format: X011 0010

NOTE 2 – RTN is not applicable to the optional T.4 error correction mode.

- 4) *Procedure Interrupt Positive (PIP)* – To indicate that a message has been received but that further transmissions are not possible without operator intervention. Failing operator intervention and if further documents are to follow, the facsimile procedure shall begin at the beginning of phase B. This is a positive response only to MPS, EOM, EOP, PRI-Q, PPS-MPS, PPS-EOM, PPS-EOP, PPS-PRI-Q.

Format: X011 0101

- 5) *Procedure Interrupt Negative (PIN)* – To indicate that the previous (or in-process) message has not been satisfactorily received and that further transmissions are not possible without operator intervention. Failing operator intervention and if further documents are to follow, the facsimile procedure shall begin at the beginning of phase B. This is a negative response only to MPS, EOM, EOP, PRI-Q, PPS-MPS, PPS-EOM, PPS-EOP, PPS-PRI-Q, EOR-MPS, EOR-EOM, EOR-EOP and EOR-PRI-Q.

Format: X011 0100

NOTE 3 – All terminals shall be able to recognize the PIN and PIP signals. The ability to transmit these signals is optional.

NOTE 4 – In the duration between partial-pages, RTP, RTN, PIP and PIN signals should not be transmitted in the optional T.4 error correction mode.

- 6) *Partial Page Request (PPR)* – This digital response is only used in the optional T.4 error correction mode. See item 1) of A.4.4.
- 7) *Receive Not Ready (RNR)* – This digital response is only used in the optional T.4 error correction mode or optional flow control mode. With respect to the optional T.4 error correction mode, see item 2) of A.4.4.
- 8) *Response for End of Retransmission (ERR)* – This digital response is only used in the optional T.4 error correction mode. See item 3) of A.4.4.
- 9) *File Diagnostics Message (FDM)* – This digital response may be used in place of MCF. See Appendix V for more information.

Format: X011 1111

NOTE 5 – Applicable only to the optional BFT mode.

5.3.6.1.8 Other line control signals

For the purpose of handling errors and controlling the state of the line.

Format: X101 XXXX

- 1) *Disconnect (DCN)* – This command indicates the initiation of phase E (call release). This command requires no response.

Format: X101 1111

- 2) *Command Repeat (CRP)* – This optional response indicates that the previous command was received in error and should be repeated in its entirety (i.e., optional frames included).

Format: X101 1000

- 3) *Field Not Valid (FNV)* – This optional signal indicates that the last received PWD, SEP, SUB, SID, TSI, PSA or secure fax signal (or any combination of these) is invalid or not accepted. FNV is only sent if bit 33 in DIS/DTC and DCS is set.

NOTE 1 – FNV shall be sent in place of CFR/FTT when the FIF of one or more optional signals associated with DCS is invalid or not accepted. FNV shall also be sent in response to the DTC when one or more of the related optional signals is invalid or not accepted. FNV may also be sent in response to the DEC, DES, DTR or DER signals (as defined in Annex H).

Format: X101 0011

- 4) *Transmit not ready (TNR)* – This optional command is used to indicate that the transmitter is not ready to transmit.

Format: X101 0111

- 5) *Transmit ready (TR)* – This optional response is used to ask for the status for transmitter.

Format: X101 0110

NOTE 2 – TNR, TR are applicable only to the optional flow control mode. The transmitter can send TNR instead of any commands after exchanging DIS/DTC and DCS signals.

5.3.6.2 Facsimile Information Field (FIF)

In many cases the FIF will be followed by the transmission of additional 8-bit octets to further clarify the facsimile procedure. This information for the basic binary coded system would consist of the definition of the information in the DIS, DCS, DTC, CSI, CIG, TSI, NSC, NSF, NSS, PWD, SEP, SUB, FDM, CTC, PPS and PPR signals.

5.3.6.2.1 DIS standard capabilities

Additional information fields will be transmitted immediately following the DIS facsimile control field. The bit assignment for this information is given in Table 2 where a 1 indicates the condition is valid, except where specifically noted otherwise (e.g., bits 11, 12, 13, 14 and 21, 22, 23).

5.3.6.2.2 DCS standard commands

When issuing the command, bits 1, 4 and 9 shall be set to 0. The DCS standard commands are formatted as shown in Table 2.

5.3.6.2.3 DTC standard commands

The DTC standard capabilities are formatted as shown in Table 2.

Table 2/T.30

Bit No.	DIS/DTC	Note	DCS	Note
1	Store and forward Internet fax- Simple mode (ITU-T Rec. T.37)	60, 63	Store and forward Internet fax- Simple mode (ITU-T Rec. T.37)	60, 63
2	Reserved	1	Reserved	1
3	Real-time Internet fax (ITU-T Rec. T.38)	61, 63	Real-time Internet fax (ITU-T Rec. T.38)	61, 63
4	3rd Generation Mobile Network	71	3rd Generation Mobile Network	71
5	Reserved	1	Reserved	1
6	V.8 capabilities	23	Invalid	24
7	"0" = 256 octets preferred "1" = 64 octets preferred	23, 42	Invalid	24
8	Reserved	1	Reserved	1

Table 2/T.30

Bit No.	DIS/DTC	Note	DCS	Note
9	Ready to transmit a facsimile document (polling)	18	Set to "0"	
10	Receiver fax operation	19	Receiver fax operation	20
11 12 13 14	<i>Data signalling rate</i>		<i>Data signalling rate</i>	
0 0 0 0	ITU-T Rec. V.27 ter fall-back mode		2400 bit/s, ITU-T Rec. V.27 <i>ter</i>	33
0 1 0 0	ITU-T Rec. V.27 <i>ter</i>	3	4800 bit/s, ITU-T Rec. V.27 <i>ter</i>	
1 0 0 0	ITU-T Rec. V.29		9600 bit/s, ITU-T Rec. V.29	
1 1 0 0	ITU-T Recs V.27 <i>ter</i> and V.29		7200 bit/s, ITU-T Rec. V.29	
0 0 1 0	Not used		Invalid	31
0 1 1 0	Reserved		Invalid	31
1 0 1 0	Not used		Reserved	
1 1 1 0	Invalid	32	Reserved	
0 0 0 1	Not used		14 400 bit/s, ITU-T Rec. V.17	
0 1 0 1	Reserved		12 000 bit/s, ITU-T Rec. V.17	
1 0 0 1	Not used		9600 bit/s, ITU-T Rec. V.17	
1 1 0 1	ITU-T Recs V.27 <i>ter</i> , V.29, and V.17	31	7200 bit/s, ITU-T Rec. V.17	
0 0 1 1	Not used		Reserved	
0 1 1 1	Reserved		Reserved	
1 0 1 1	Not used		Reserved	
1 1 1 1	Reserved		Reserved	
15	R8 × 7.7 lines/mm and/or 200 × 200 pels/25.4 mm	10, 11, 13, 25, 34	R8 × 7.7 lines/mm or 200 × 200 pels/25.4 mm	10, 11, 13, 25, 34
16	Two-dimensional coding capability		Two-dimensional coding	
17 18	<i>Recording width capabilities</i>	27	<i>Recording width</i>	27
0 0	Scan line length 215 mm ± 1%		Scan line length 215 mm ± 1%	
0 1	Scan line length 215 mm ± 1% and Scan line length 255 mm ± 1% and Scan line length 303 mm ± 1%		Scan line length 303 mm ± 1%	
1 0	Scan line length 215 mm ± 1% and Scan line length 255 mm ± 1%		Scan line length 255 mm ± 1%	
1 1	Invalid	6	Invalid	

Table 2/T.30

Bit No.	DIS/DTC	Note	DCS	Note
19 20 0 0 0 1 1 0 1 1	<i>Recording length capability</i> A4 (297 mm) Unlimited A4 (297 mm) and B4 (364 mm) Invalid	2	<i>Recording length</i> A4 (297 mm) Unlimited B4 (364 mm) Invalid	2
21 22 23 0 0 0 0 0 1 0 1 0 1 0 0 0 1 1 1 1 0 1 0 1 1 1 1	<i>Minimum scan line time capability at the receiver</i> 20 ms at 3.85 l/mm: $T_{77} = T_{3.85}$ 40 ms at 3.85 l/mm: $T_{77} = T_{3.85}$ 10 ms at 3.85 l/mm: $T_{77} = T_{3.85}$ 5 ms at 3.85 l/mm: $T_{77} = T_{3.85}$ 10 ms at 3.85 l/mm: $T_{77} = 1/2 T_{3.85}$ 20 ms at 3.85 l/mm: $T_{77} = 1/2 T_{3.85}$ 40 ms at 3.85 l/mm: $T_{77} = 1/2 T_{3.85}$ 0 ms at 3.85 l/mm: $T_{77} = T_{3.85}$	4, 8, 23	<i>Minimum scan line time</i> 20 ms 40 ms 10 ms 5 ms 0 ms	8, 24
24	Extend field	5	Extend field	5
25	Reserved	1, 41	Reserved	1, 41
26	Uncompressed mode		Uncompressed mode	
27	Error correction mode	17	Error correction mode	17
28	Set to "0"		Frame size 0 = 256 octets Frame size 1 = 64 octets	7 24
29	Reserved	1	Reserved	1
30	Reserved	1	Reserved	1
31	T.6 coding capability	9, 17	T.6 coding enabled	9, 17
32	Extend field	5	Extend field	5
33	Field not valid capability		Field not valid capability	
34	Multiple selective polling capability	52	Set to "0"	
35	Polled Subaddress	26, 44, 45	Set to "0"	
36	T.43 coding	17, 25, 34, 35, 37, 39, 40	T.43 coding	17, 25, 34, 35, 37, 39, 40
37	Plane interleave	25, 46	Plane interleave	25, 46

Table 2/T.30

Bit No.	DIS/DTC	Note	DCS	Note
38	Voice coding with 32 k ADPCM (ITU-T Rec. G.726)	58, 59	Voice coding with 32 k ADPCM (ITU-T Rec. G.726)	17, 58, 59
39	Reserved for the use of extended voice coding	1	Reserved for the use of extended voice coding	1
40	Extend field	5	Extend field	5
41	$R8 \times 15.4$ lines/mm	10, 62	$R8 \times 15.4$ lines/mm	10, 62
42	300×300 pels/25.4 mm	34, 80	300×300 pels/25.4 mm	34
43	$R16 \times 15.4$ lines/mm and/or 400×400 pels/25.4 mm	10, 12, 13, 34, 80	$R16 \times 15.4$ lines/mm and/or 400×400 pels/25.4 mm	10, 12, 13, 34
44	Inch-based resolution preferred	13, 14	Resolution-type selection "0": metric-based resolution "1": inch-based resolution	13, 14
45	Metric-based resolution preferred	13, 14	Don't care	
46	Minimum scan line time capability for higher resolutions "0": $T_{154} = T_{77}$ "1": $T_{154} = 1/2 T_{77}$	15	Don't care	
47	Selective polling	26, 44	Set to "0"	
48	Extend field	5	Extend field	5
49	Subaddressing capability		Subaddressing transmission	26
50	Password	26	Sender Identification transmission	26
51	Ready to transmit a data file (polling)	17, 21	Set to "0"	
52	Reserved	1	Reserved	1
53	Binary File Transfer (BFT)	16, 17, 21	Binary File Transfer (BFT)	16, 17
54	Document Transfer Mode (DTM)	17, 21	Document Transfer Mode (DTM)	17
55	Electronic Data Interchange (EDI)	17, 21	Electronic Data Interchange (EDI)	17
56	Extend field	5	Extend field	5
57	Basic Transfer Mode (BTM)	17, 21	Basic Transfer Mode (BTM)	17, 59
58	Reserved	1	Reserved	1
59	Ready to transmit a character or mixed mode document (polling)	17, 22	Set to "0"	
60	Character mode	17, 22	Character mode	17
61	Reserved	1	Reserved	1
62	Mixed mode (Annex E/T.4)	17, 22	Mixed mode (Annex E/T.4)	17, 22

Table 2/T.30

Bit No.	DIS/DTC	Note	DCS	Note
63	Reserved	1	Reserved	1
64	Extend field	5	Extend field	5
65	Processable mode 26 (ITU-T Rec. T.505)	17, 22	Processable mode 26 (ITU-T Rec. T.505)	17, 22
66	Digital network capability	43	Digital network capability	43
67 0 1	<i>Duplex and half-duplex capabilities</i> Half-duplex operation only Duplex and half-duplex operation		<i>Duplex and half-duplex capabilities</i> Half-duplex operation only Duplex operation	
68	JPEG coding	17, 25, 34, 35, 39, 40	Full colour mode	17, 25, 34, 35, 39, 40
69	Full colour mode	25, 35	Full colour mode	25, 35
70	Set to "0"	36	Preferred Huffman tables	25, 36
71	12 bits/pel component	25, 37	12 bits/pel component	25, 37
72	Extend field	5	Extend field	5
73	No subsampling (1:1:1)	25, 38	No subsampling (1:1:1)	25, 38
74	Custom illuminant	25, 39	Custom illuminant	25, 39
75	Custom gamut range	25, 40	Custom gamut range	25, 40
76	North American Letter (215.9 × 279.4 mm) capability	28	North American Letter (215.9 × 279.4 mm)	
77	North American Legal (215.9 × 355.6 mm) capability	28	North American Legal (215.9 × 355.6 mm)	
78	Single-progression sequential coding (ITU-T Rec. T.85) basic capability	17, 29, 30	Single-progression sequential coding (ITU-T Rec. T.85) basic	17, 29
79	Single-progression sequential coding (ITU-T Rec. T.85) optional L0 capability	17, 29, 30	Single-progression sequential coding (ITU-T Rec. T.85) optional L0	17, 29
80	Extend field	5	Extend field	5
81	HKM key management capability		HKM key management selected	
82	RSA key management capability		RSA key management selected	47
83	Override capability	53	Override mode selected	53
84	HFX40 cipher capability		HFX40 cipher selected	
85	Alternative cipher number 2 capability	56	Alternative cipher number 2 selected	56
86	Alternative cipher number 3 capability	56	Alternative cipher number 3 selected	56
87	HFX40-I hashing capability		HFX40-I hashing selected	
88	Extend field	5	Extend field	5

Table 2/T.30

Bit No.	DIS/DTC	Note	DCS	Note
89	Alternative hashing system number 2 capability	57	Alternative hashing system number 2 selected	57
90	Alternative hashing system number 3 capability	57	Alternative hashing system number 3 selected	57
91	Reserved for future security features	1	Reserved for future security features	1
92	T.44 (Mixed Raster Content)	17, 50, 69	T.44 (Mixed Raster Content)	17, 50, 69
93	T.44 (Mixed Raster Content)	17, 50, 69	T.44 (Mixed Raster Content)	17, 50, 69
94	T.44 (Mixed Raster Content)	17, 50, 69	T.44 (Mixed Raster Content)	17, 50, 69
95	Page length maximum strip size for T.44 (Mixed Raster Content)	51	Page length maximum strip size for T.44 (Mixed Raster Content)	51
96	Extend field	5	Extend field	5
97	Colour/gray-scale 300 pels/25.4 mm × 300 lines/25.4 mm or 400 pels/25.4 mm × 400 lines/25.4 mm resolution	49, 80	Colour/gray-scale 300 pels/25.4 mm × 300 lines/25.4 mm or 400 pels/25.4 mm × 400 lines/25.4 mm resolution	49
98	100 pels/25.4 mm × 100 lines/25.4 mm for colour/gray scale	10, 48	100 pels/25.4 mm × 100 lines/25.4 mm for colour/gray scale	10, 48
99	Simple Phase C BFT Negotiations capability	54, 55	Simple Phase C BFT Negotiations capability	54, 55
100	Extended BFT Negotiations capability		Set to "0"	
101	Internet Selective Polling Address (ISP)	26	Set to "0"	
102	Internet Routing Address (IRA)	26	Internet Routing Address (IRA) transmission	26
103	Reserved	1	Reserved	1
104	Extend field	5	Extend field	5
105	600 pels/25.4 mm × 600 lines/25.4 mm	81	600 pels/25.4 mm × 600 lines/25.4 mm	
106	1200 pels/25.4 mm × 1200 lines/25.4 mm	81	1200 pels/25.4 mm × 1200 lines/25.4 mm	
107	300 pels/25.4 mm × 600 lines/25.4 mm	62	300 pels/25.4 mm × 600 pels/25.4 mm	62
108	400 pels/25.4 mm × 800 lines/25.4 mm	62	400 pels/25.4 mm × 800 lines/25.4 mm	62
109	600 pels/25.4 mm × 1200 lines/25.4 mm	62	600 pels/25.4 mm × 1200 lines/25.4 mm	62

Table 2/T.30

Bit No.	DIS/DTC	Note	DCS	Note
110	Colour/gray scale 600 pels/25.4 mm × 600 lines/25.4 mm resolution	64, 81	Colour/gray scale 600 pels/25.4 mm × 600 lines/25.4 mm resolution	64
111	Colour/gray scale 1200 pels/25.4 mm × 1200 lines/25.4 mm resolution	65, 81	Colour/gray scale 1200 pels/25.4 mm × 1200 lines/25.4 mm resolution	65
112	Field Extend	5	Field Extend	5
113	Double-sided printing capability (alternate mode)	66, 67	Double-sided printing capability (alternate mode)	67
114	Double-sided printing capability (continuous mode)	66, 67, 68	Double-sided printing capability (continuous mode)	67
115	Black and white mixed raster content profile (MRCbw)	17, 50, 69	Not used set to "0"	17, 50, 69
116	T.45 (run length colour encoding)	17, 78	T.45 (run length colour encoding)	17, 78
117 118 0 0 0 1 1 0 1 1	<i>SharedDataMemory capacity</i> Not available Level 1 = 1.0 Mbytes Level 2 = 2.0 Mbytes Level 3 = unlimited (i.e., ≥32 Mbytes)	70	<i>SharedDataMemory required</i> Not Used Level 1 = 1.0 Mbytes Level 2 = 2.0 Mbytes Level 3 = unlimited (i.e., ≥32 Mbytes)	70
119	T.44 Colour Space	83	T.44 Colour Space	83
120	Extend field		Extend field	
121	Flow Control Capability for T.38 communication	72, 73	Flow Control Capability for T.38 communication	72, 73
122	K>4	74	K>4	74
123	Internet aware T.38 mode fax device capability	75	Internet aware fax device operating in T.38 mode	76, 77
124 125 126 0 0 0 0 0 1 0 1 0 0 1 1 1 0 0 1 0 1 1 1 0 1 1 1	<i>T.89 (Application profiles for ITU-T Rec. T.88)</i> Not used Profile 1 Profile 2 Profile 3 Profiles 2 and 3 Reserved Reserved Reserved	78, 79	<i>T.89 (Application profiles for ITU-T Rec. T.88)</i> Not used Profile 1 Profile 2 Profile 3 Invalid Reserved Reserved Reserved	78, 79
127	sYCC-JPEG coding	17, 82	sYCC-JPEG coding	17, 82

Table 2/T.30

NOTE 1 – Bits that are indicated as "Reserved" shall be set to "0".

NOTE 2 – Standard facsimile terminals conforming to ITU-T Rec. T.4 must have the following capability:
Paper length = 297 mm.

NOTE 3 – Where the DIS or DTC frame defines V.27 *ter* capabilities, the terminal may be assumed to be operable at either 4800 or 2400 bit/s.

Where the DIS or DTC frame defines V.29 capabilities, the terminal may be assumed to be operable at either 9600 or 7200 bit/s per ITU-T Rec. V.29; where it defines ITU-T Rec. V.17, the terminal may be assumed to be operable at 14 400 bit/s, 12 000 bit/s, 9600 bit/s or 7200 bit/s per ITU-T Rec. V.17.

NOTE 4 – T_{77} and T_{385} refer to the scan line times to be utilized when the vertical resolution is 7.7 lines/mm (or 200 lines/25.4 mm or 300 lines/25.4 mm) or 3.85 lines/mm, respectively (see bit 15 above). $T_{77} = 1/2 T_{385}$ indicates that when the vertical resolution is 7.7 lines/mm or 200 lines/25.4 mm or 300 lines/25.4 mm, the scan line time can be decreased by half.

NOTE 5 – The standard FIF field for the DIS, DTC and DCS signals is 24 bits long. If the "extend field" bit(s) is a "1", the FIF field shall be extended by an additional 8 bits.

NOTE 6 – Existing terminals may send the invalid (1,1) condition for bits 17 and 18 of their DIS signal. If such signal is received, it should be interpreted as (0,1).

NOTE 7 – The values of bit No. 28 in the DCS command is valid only when the indication of the T.4 error correction mode is invoked by bit 27.

NOTE 8 – The optional T.4 error correction mode of operation and IAFD mode require 0 ms of the minimum scan line time capability. Bits 21-23 in DIS/DTC signals indicate the minimum scan line time of a receiver regardless of the availability of the error correction mode and IAFD mode.

In case of error correction mode and IAFD mode, the sender sends DCS signal with bits 21-23 set to "1, 1, 1" indicating 0 ms capability.

In case of normal transmission, the sender sends DCS signal with bits 21-23 set to the appropriateness according to the capabilities of the two terminals.

NOTE 9 – T.6 coding scheme capability specified by bit 31 is valid only when bit 27 (error correction mode) is set as a "1".

NOTE 10 – Resolutions of R4, R8 and R16 are defined as follows:

R4 = 864 pels/(215 mm \pm 1%) for ISO A4, North American Letter and Legal.

R4 = 1024 pels/(255 mm \pm 1%) for ISO B4.

R4 = 1216 pels/(303 mm \pm 1%) for ISO A3.

R8 = 1728 pels/(215 mm \pm 1%) for ISO A4, North American Legal and Letter.

R8 = 2048 pels/(255 mm \pm 1%) for ISO B4.

R8 = 2432 pels/(303 mm \pm 1%) for ISO A3.

R16 = 3456 pels/(215 mm \pm 1%) for ISO A4, North American Letter and Legal.

R16 = 4096 pels/(255 mm \pm 1%) for ISO B4.

R16 = 4864 pels/(303 mm \pm 1%) for ISO A3.

NOTE 11 – Bit 15, when set to "1", is interpreted according to bit 44 and 45 as follows:

Bit 44	Bit 45	Interpretation
0	0	(invalid)
1	0	200 pels/25.4 mm \times 200 lines/25.4 mm
0	1	R8 \times 7.7 lines/mm
1	1	R8 \times 7.7 lines/mm and 200 pels/25.4 mm \times 200 lines/25.4 mm
"1" in bit 15 without bits 41, 42, 43, 44, 45 and 46 indicates R8 \times 7.7 lines/mm.		

Table 2/T.30

NOTE 12 – Bit 43, when set to "1", is interpreted according to bit 44 and 45 as follows:

Bit 44	Bit 45	Interpretation
0	0	(invalid)
1	0	400 pels/25.4 mm × 400 lines/25.4 mm
0	1	R16 × 15.4 lines/mm
1	1	R16 × 15.4 lines/mm and 400 pels/25.4 mm × 400 lines/25.4 mm.

NOTE 13 – Bits 44 and 45 are used only in conjunction with bits 15 and 43. Bit 44 in DCS, when used, shall correctly indicate the resolution of the transmitted document, which means that bit 44 in DCS may not always match the indication of bits 44 and 45 in DIS/DTC. Cross selection will cause the distortion and reduction of reproducible area.

If a receiver indicates in DIS that it prefers to receive metric-based information, but the transmitter has only the equivalent inch-based information (or vice versa), then communication shall still take place.

NOTE 14 – Bits 44 and 45 do not require the provision of any additional features on the terminal to indicate to the sending or receiving user whether the information was transmitted or received on a metric-metric, inch-inch, metric-inch, inch-metric basis.

NOTE 15 – $T_{15.4}$ refers to the scan line times to be utilized when the vertical resolution is 15.4 lines/mm, 400 lines/25.4 mm, 600 lines/25.4 mm and 1200 lines/25.4 mm.

$T_{15.4} = 1/2 T_{7.7}$ indicates that when $T_{7.7}$ is 10, 20 or 40 ms, the scan line time can be decreased by half in higher resolution mode.

When $T_{7.7}$ is 5 ms [i.e., (bit 21, bit 22, bit 23) = (1,0,0), (0,1,1)] or 0 ms [i.e., (1,1,1)], bit 46 in DIS/DTC should be set to "0" ($T_{15.4} = T_{7.7}$).

NOTE 16 – The binary file transfer protocol is described in ITU-T Rec. T.434.

NOTE 17 – When either bit of 31, 36, 38, 51, 53, 54, 55, 57, 59, 60, 62, 65, 68, 78, 79, 115, 116 and 127 is set to "1", bit 27 shall also be set to "1". If the value of bits 92 to 94 is non-zero, then bit 27 shall be set to "1".

NOTE 18 – Bit 9 indicates that there is a facsimile document ready to be polled from the answering terminal. It is not an indication of a capability.

NOTE 19 – Bit 10 indicates that the answering terminal has receiving capabilities.

NOTE 20 – Bit 10 in DCS is a command to the receiving terminal to set itself in the receive mode.

NOTE 21 – Bit 51 indicates that there is a data file ready to be polled from the answering terminal. It is not an indication of a capability. This bit is used in conjunction with bits 53, 54, 55 and 57.

NOTE 22 – Bit 59 indicates that there is a character-coded or mixed-mode document ready to be polled from the answering terminal. It is not an indication of a capability. This bit is used in conjunction with bits 60, 62 and 65.

NOTE 23 – When the optional procedure defined in Annex C is used, in DIS/DTC bits 6 and 7 shall be set to "0" and bits 21 to 23 and 27 shall be set to "1".

NOTE 24 – When the optional procedure defined in Annex C is used, in DCS bits 6, 7 and 28 shall be set to "0" and bits 21 to 23 and 27 shall be set to "1".

NOTE 25 – The optional continuous-tone colour mode and gray-scale mode (JPEG mode) protocols and the optional lossless encoded colour and gray-scale mode (T.43 mode) are described in Annexes E and I respectively. If bit 68 in the DIS/DTC frame is set to "1", this indicates JPEG mode capability. If bits 36 and 68 are set to "1", this indicates that the T.43 capability is also available. Bit 36 in the DIS/DTC frame shall only be set to "1" when bit 68 is also set to "1". Additionally, then bits 15 and 27 in the DIS/DTC frame shall also be set to "1", if bit 68 or bits 36 and 68 are set to "1". Bit 15 indicates 200 pels/25.4 mm × 200 lines/25.4 mm resolution capability, which is basic for colour facsimile. Bit 27 indicates error correction mode capability, which is mandatory for colour facsimile. Bits 69 to 71, 73 to 75 and 92 to 94

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are relevant only if bit 68 is set to "1". Bit 73 is relevant only for JPEG mode. Bits 69, 71, 74 and 75 are relevant for JPEG mode and/or T.43 mode. Bit 37 is relevant only when bit 36 is set to "1" – see also Notes 39 and 40.

NOTE 26 – To provide an error recovery mechanism, when PWD/SEP/SUB/SID/PSA/IRA/ISP frames are sent with DCS or DTC, bits 49, 102 and 50 in DCS or bits 47, 101, 50 and 35 in DTC shall be set to "1" with the following meaning:

Bit set to "1"	DIS	DTC	DCS
35	Polled SubAddress capability	Polled SubAddress transmission	Not allowed – set to "0"
47	Selective polling capability	Selective polling transmission	Not allowed – set to "0"
49	Subaddressing capability	Not allowed (Set to "0")	Subaddressing transmission
50	Password	Password transmission	Sender Identification transmission
101	Internet Selective Polling Address capability	Internet Selective Polling Address transmission	Not allowed – set to "0"
102	Internet Routing Address capability	Not allowed (Set to "0")	Internet Routing Address transmission

Terminals conforming to the 1993 version of this Recommendation may set the above bits to "0" even though PWD/SEP/SUB frames are transmitted.

NOTE 27 – The corresponding scan line lengths for inch-based resolutions can be found in clause 3/T.4.

NOTE 28 – While using bits 76 and 77 in DIS/DTC, the terminal is required to be able to receive ISO A4 documents in every combination of bits 76 and 77. A4, B4 and A3 transmitters may ignore the settings of bits 76 and 77.

NOTE 29 – The coding scheme indicated by bits 78 and 79 is defined in ITU-T Rec. T.85.

NOTE 30 – When bit 79 in DIS is set to "1", bit 78 shall also be set to "1".

NOTE 31 – In the case of setting (1,1,0,1) in DIS/DTC bits 11-14 in order to announce the capability to receive in ITU-T Rec. V.17, some terminals which conform to the 1994 version and earlier versions of this Recommendation recognize the capability to receive in ITU-T Rec. V.33 and may set (0,0,1,0) or (0,1,1,0) in DCS bits 11-14. Therefore, the terminal which has the capability to receive, using the modulation system defined in ITU-T Rec. V.17, may optionally support the capability to receive using the modulation system defined in ITU-T Rec. V.33.

NOTE 32 – Some terminals which conform to the 1994 and earlier versions of this Recommendation may have used this bit sequence to indicate use of the V.27ter, V.29 and V.33 modulation system.

NOTE 33 – When the modulation system defined in ITU-T Rec. V.34 is used or Internet-Aware Fax Device in DCS (Bit 123) is set to "1", bits 11-14 in DCS are invalid and should be set to "0".

NOTE 34 – Setting bit 68 to "0" indicates that the called terminal's JPEG mode and T.43 mode are not available and it cannot decode JPEG or T.43 encoded data. In a DCS frame, setting bit 68 to "1" indicates that the calling terminal's JPEG mode is used and JPEG encoded image data are sent. The horizontal image size parameter X of the JPEG data stream shall conform to the values defined in clause 2/T.4. Setting bit 68 to "0" and bit 36 to "1" indicates that the calling terminal's T.43 mode is used and T.43 encoded image data are sent. In the DCS frame, if bit 68 or 36 is set to "1" or the value of bits 92 to 94 is non-zero, then bits 15 or 42 or 43 or 98 or 105 or 106 and 27 in the DCS frame shall also be set to "1". Bits 98, 42, 43, 105 and 106 indicate 100 × 100, 300 × 300 and 400 × 400, 600 × 600 and 1200 pels/25.4 mm × 1200 lines/25.4 mm resolution respectively. Setting bit 68 and 36 to "0" indicates neither the JPEG mode nor the T.43 mode is used, image is not encoded using JPEG nor T.43.

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NOTE 35 – In a DIS/DTC frame, setting bit 69 to "1" indicates that the called terminal has full colour capability. It can accept full colour image data in CIELAB space. If bit 36 is also set to "1", it can also accept colour image defined in ITU-T Rec. T.43. Setting bit 69 to "0" and bit 68 or bits 36 and 68 to "1" indicates that the called terminal has gray-scale mode only, it accepts only the lightness component (the L* component) in the CIELAB representation for JPEG mode and for T.43 mode respectively. In a DCS frame, setting bits 68 and 69 to "1" indicates that the calling terminal sends image in full colour representation in the CIELAB space in JPEG mode. In a DCS frame, setting bits 36 and 69 to "1" indicates that the calling terminal sends colour image in T.43 mode. Setting bit 36 or 68 to "1" and bit 69 to "0" indicates that the calling terminal sends only the lightness component (the L* component) in the CIELAB representation for JPEG or T.43 mode respectively. Note that colour image will be transmitted only when bits 68 and 69 or 36 and 69 are both set to "1".

NOTE 36 – Bit 70 is called "Indication of default Huffman tables". A means is provided to indicate to the called terminal that the Huffman tables are the default tables. Default tables are specified only for the default image intensity resolution (8 bits/pel/component). The default Huffman tables are to be determined (for example, Tables K.3 to K.6/T.81). In a DIS/DTC frame, bit 70 is not used and is set to zero. In a DCS frame, setting bit 70 to 0 indicates that the calling terminal does not identify the Huffman tables that it uses to encode the image data as the default tables. Setting bit 70 to "1" indicates that the calling terminal identifies the Huffman tables that it uses to encode the image data as the default tables.

NOTE 37 – In a DIS/DTC frame, setting bit 71 to "0" indicates that the called terminal can only accept image data which has been digitized to 8 bits/pel/component for JPEG mode. This is also true for T.43 mode if bit 36 is also set to "1". Setting bit 71 to "1" indicates that the called terminal can also accept image data that are digitized to 12 bits/pel/component for JPEG mode. This is also true for T.43 mode if bit 36 is also set to "1". In a DCS frame, setting bit 71 to "0" indicates that the calling terminal's image data are digitized to 8 bits/pel/component for JPEG mode. This is also true for T.43 mode if bit 36 is also set to "1". Setting bit 71 to "1" indicates that the calling terminal transmits image data which has been digitized to 12 bits/pel/component for JPEG mode. This is also true for T.43 mode if bit 36 is also set to "1".

NOTE 38 – In a DIS/DTC frame, setting bit 73 to "0" indicates that the called terminal expects a 4:1:1 subsampling ratio of the chrominance components in the image data; the a* and b* components in the CIELAB colour space representation are subsampled four times to one against the L* (Lightness) component. The details are described in Annex E/T.4. Setting bit 73 to "1" indicates that the called terminal, as an option, accepts no subsampling in the chrominance components in the image data. In a DCS frame, setting bit 73 to "0" indicates that the called terminal uses a 4:1:1 subsampling ratio of the a* and b* components in the image data. Setting bit 73 to "1" indicates that the called terminal does no subsampling.

NOTE 39 – In a DIS/DTC frame, setting bit 74 to "0" indicates that the called terminal expects that the CIE Standard Illuminant D50 is used in the colour image data as specified in ITU-T Rec. T.42/LAB or the CIE Standard Illuminant D65 is used in the colour image data as specified in ITU-T Rec. T.42/YCC. Setting bit 74 to "1" indicates that the called terminal can also accept other illuminant types besides the D50 illuminant only for LAB. Setting bit 68 to "1" indicates that the terminal has the JPEG coding capability as described in Annex E/T.4. Setting bit 36 to "1" indicates that the terminal has the colour coding capability as described in ITU-T Rec. T.43. In a DCS frame, setting bit 74 to "0" and bit 68 or bit 36 to "1", indicates the calling terminal uses the D50 illuminant in the colour image data representation as specified in ITU-T Rec. T.42/LAB. Setting bit 74 to "1" indicates that another type of illuminant is used for LAB. When bits 68 and 74 are set to "1" the specification is embedded into the JPEG syntax as described in Annex E/T.4. When bits 36 and 74 are set to "1", the specification is embedded into the T.43 syntax as described in ITU-T Rec. T.43. Setting one or more of bits 92-94 to "1" indicates that the terminal has the MRC coding capability as described in ITU-T Rec. T.44. Available illuminants for all combinations of bit 74, 92, 93, 94 and 119 are shown in the following table.

Table 2/T.30**Available illuminant for DIS/DTC bits 74, 92, 93, 94 and 119**

Bit					Mode of T.44 and available illuminant for colour space	
74	92	93	94	119	Mode of T.44	Available Illuminant for colour space
0	1	0	0	0	Mode 1	Only D50 for LAB
0	1	0	0	1	Mode 1	Only D65 for YCC
0	x	1	x	0	Mode 2 or higher	Only D50 for LAB
	x	x	1			
0	x	1	x	1	Mode 2 or higher	D50 and other illuminant for LAB
	x	x	1			
1	1	0	0	0	Mode 1	D50 and other illuminant for LAB
1	1	0	0	1	Mode 1	Invalid
1	x	1	x	0	Mode 2 or higher	D50 and other illuminant for LAB
	x	x	1			
1	x	1	x	1	Mode 2 or higher	D50 and other illuminant for LAB and D65 for YCC
	x	x	1			

x: 0 or 1

Illuminant for DCS bits 74, 92, 93, 94 and 119

Bit					Mode of T.44 and illuminant for colour space	
74	92	93	94	119	Mode of T.44	Illuminant for colour space
0	1	0	0	0	Mode 1	D50 for LAB
0	1	0	0	1	Mode 1	D65 for YCC
0	x	1	x	0	Mode 2 or higher	D50 for LAB
	x	x	1			
0	x	1	x	1	Mode 2 or higher	D65 for YCC or mixing of D65 for YCC and D50 for LAB
	x	x	1			
1	1	0	0	0	Mode 1	D50 and/or other illuminant for LAB
1	1	0	0	1	Mode 1	Invalid
1	x	1	x	0	Mode 2 or higher	D50 and/or other illuminant for LAB
	x	x	1			
1	x	1	x	1	Mode 2 or higher	D65 for YCC or mixing of D65 for YCC and D50 and/or other illuminant for LAB
	x	x	1			

x: 0 or 1

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NOTE 40 – In a DIS/DTC frame, setting bit 75 to "0" indicates that the called terminal expects that the colour image data are represented using the default gamut range as specified in ITU-T Rec. T.42/LAB or T.42/YCC. Setting bit 75 to "1" indicates that the called terminal can also accept other gamut ranges. Setting bit 68 to "1" indicates that the terminal has the JPEG coding capability, as described in Annex E/T.4. Setting bit 36 to "1" indicates that the terminal has the colour coding capability, as described in ITU-T Rec. T.43. In a DCS frame, setting bit 75 to "0" and bit 68 or bit 36 to "1", indicates that the calling terminal uses the default gamut range as specified in ITU-T Rec. T.42/LAB. Setting bit 75 to "1" indicates that the calling terminal uses a different gamut range for LAB. When bits 68 and 75 are set to "1", the specification is embedded into the JPEG syntax as described in Annex E/T.4. When bits 36 and 75 are set to "1", the specification is embedded into the T.43 syntax as described in ITU-T Rec. T.43. When one or more of bits 92-94 and bit 75 are set to "1", the specification is embedded into the MRC syntax as described in ITU-T Recs T.42 and T.44.

NOTE 41 – Some terminals which conform to the pre-1996 versions of this Recommendation may set this bit to "1". Such terminals will give an answering sequence as shown in Figure III.2.

NOTE 42 – It is understood that for backwards compatibility, a transmitting terminal may ignore the request for the 64-octet frame and therefore the receiving terminal must be prepared to handle 256-octet frames by some means.

NOTE 43 – See C.7.2.

NOTE 44 – Clarification on the use of selective polling based on the settings of bit 47 and bit 35 is given in 5.3.6.1.2, item 5).

NOTE 45 – Clarification on the use of subaddress for polling based on the setting of bit 35 is given in 5.3.6.1.2, item 6).

NOTE 46 – In a DIS/DTC frame, setting bit 37 to "0" indicates that the called terminal can only accept image data that are interleaved by stripe interleave (128 line/stripe or less). Setting bit 37 to "1" indicates that the called terminal can also accept plane interleaved image data. In a DCS frame, setting bit 37 to "0" indicates that the calling terminal's image data are interleaved through stripe interleave. Setting bit 37 to "1" indicates that the calling terminal's image data are interleaved through plane interleave. The detail of both interleaving methods are described in ITU-T Rec. T.43.

NOTE 47 – The DCS is not emitted in the context of Annex H; FIF of DCS is included within the new signal "DEC" (see H.6.1) where the corresponding bit 82 must be set to "1".

NOTE 48 – In a DIS/DTC frame, setting bit 98 to "0" indicates that the called terminal does not have the capability to accept 100 pels/25.4 mm × 100 lines/25.4 mm spatial resolution for colour or gray-scale images. Setting bit 98 to "1" indicates that the called terminal does have the capability to accept 100 pels/25.4 mm × 100 lines/25.4 mm spatial resolution for colour or gray-scale images. Bit 98 is valid only when bit 68 is set to "1". In a DCS frame, setting bit 98 to "0" indicates that the calling terminal does not use 100 pels/25.4 mm × 100 lines/25.4 mm spatial resolution for colour or gray-scale images. Setting bit 98 to "1" indicates that the calling terminal uses 100 pels/25.4 mm × 100 lines/25.4 mm spatial resolution for colour or gray-scale images.

NOTE 49 – In a DIS/DTC frame, setting bit 97 to "0" indicates that the called terminal does not have the capability to accept 300 pels/25.4 mm × 300 lines/25.4 mm or 400 pels/25.4 mm × 400 lines/25.4 mm resolutions for colour/gray-scale images or T.44 Mixed Raster Content (MRC) mask layer. Setting bit 97 to "1" indicates that the called terminal does have the capability to accept 300 pels/25.4 mm × 300 lines/25.4 mm or 400 pels/25.4 mm × 400 lines/25.4 mm resolutions for colour/gray-scale images and MRC mask layer. Bit 97 is valid only when bits 68 and 42 or 43 (300 pels/25.4 mm × 300 lines/25.4 mm or 400 pels/25.4 mm × 400 lines/25.4 mm) are set to "1". In a DCS frame, setting bit 97 to "0" indicates that the calling terminal does not use 300 pels/25.4 mm × 300 lines/25.4 mm or 400 pels/25.4 mm × 400 lines/25.4 mm resolutions for colour/gray-scale images and mask layer. Setting bit 97 to "1" indicates that the calling terminal uses 300 pels/25.4 mm × 300 lines/25.4 mm or 400 pels/25.4 mm × 400 lines/25.4 mm resolutions for colour/gray-scale images and MRC mask layer. Bit 97 is valid only when bits 68 and 42 or 43 (300 pels/25.4 mm × 300 lines/25.4 mm and 400 pels/25.4 mm × 400 lines/25.4 mm) are set to "1".

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NOTE 50 – In a DIS/DTC frame, setting the value of bits 92 through 94 to "0" indicates that the called terminal does not have the capability to accept T.44 Mixed Raster Content (MRC) pages. Setting the value of bits 92 through 94 to non-zero (>0) indicates that the called terminal does have the capability to accept MRC pages. Bits 92 through 94 are valid only when bit 68 or 115 is set to "1". In a DCS frame, setting the value of bits 92 through 94 to "0" indicates that the calling terminal does not transmit MRC pages. Setting the value of bits 92 through 94 to non-zero (>0) indicates that the calling terminal transmits MRC colour or black-and-white only pages. The non-zero value of bits 92 through 94, ranging from X'01' to X'07', identifies the greatest functional mode (performance level) of MRC that is supported, as per ITU-T Rec. T.44. For hexadecimal value interpretation, bit 94 is defined as the MSB while bit 92 is the LSB (e.g., 100 for mode X'01'). Mode value X'01' identifies the base mode of T.44, each incremental mode shall support the capabilities defined in the previous mode. In the DIS/DTC, setting the mode value >0 together with bit 68 or 115 defines the capabilities, of the colour (as defined in T.44) or black-and-white only (MRCbw as defined in Annex H/T.4) profiles of MRC respectively, that are supported by the called terminal. In the DCS frame, the mode value may be set to any value less than or equal to that identified in the called terminals DIS/DTC frame. The mode value identified in the DCS frame defines the greatest MRC mode that will be applied to the transmitted data stream.

NOTE 51 – In a DIS/DTC frame, setting bit 95 to "0" indicates that the called terminal does not have the capability to accept page length maximum stripe size when receiving T.44 Mixed Raster Content (MRC) pages. Setting bit 95 to 1 indicates that the called terminal does have the capability to accept page length maximum stripe size when receiving MRC pages. Bit 95 is valid only when the value of bits 92 through 94 is set non-zero (>0). In a DCS frame, setting bit 95 to 0 indicates that the calling terminal does not use page length maximum stripe size when transmitting MRC pages. Setting bit 95 to "1" indicates that the calling terminal uses page length maximum stripe size when transmitting MRC pages. Bit 95 is valid only when the value of bits 92 through 94 is non-zero (>0).

NOTE 52 – If bit 34 in a DIS frame is set to "1", this indicates the transmitter has multiple selective polling capability. If bit 34 in a DTC frame is set to "1", this indicates additional selection of document continues after current one. The transmitter can send EOS after the transmission of the final page of current document only if bit 34 in the received DTC is set to "1".

NOTE 53 – Bit 83 is used in the scope of Annex G (see G.2.3) and Annex D/T.36 (see D.2/T.36).

NOTE 54 – Bit 99 indicates the use of the simple Phase C BFT negotiation method defined in Annex B. Some appropriate examples are given in Appendix V.

NOTE 55 – The BFT negotiations capability specified by bit 99 is valid only when bit 53 (binary file transfer) is set to "1".

NOTE 56 – Bits 85 and 86 are reserved for future enhancement to Annex D/T.36.

NOTE 57 – Bits 89 and 90 are reserved for future enhancement to Annex E/T.36.

NOTE 58 – Bits 38 and 39 are used in the scope of Annex B/T.4 (see B.4.5/T.4).

NOTE 59 – When bit 38 and 39 are set to "1", bit 57 shall also be set to "1".

NOTE 60 – Bit 1 set to "1" indicates that the terminal has the Simple mode capability defined in ITU-T Rec. T.37.

NOTE 61 – Bit 3 set to "1" indicates that the terminal has the capability to communicate using ITU-T Rec. T.38.

NOTE 62 – Non-square resolutions are applicable only to black and white images.

NOTE 63 – Internet address signals CIA, TSA or CSA can be sent and received when Internet capabilities, bit 1 or 3 of DIS, DCS and DTC, are indicated. When a terminal indicates Internet capabilities by DIS, DCS or DTC of bit 1 or 3, the recipient terminal may process or ignore these signals.

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NOTE 64 – In a DIS/DTC frame, setting bit 110 to "0" indicates that the called terminal does not have the capability to accept 600 pels/25.4 mm × 600 lines/25.4 mm resolutions for colour/gray-scale images or T.44 Mixed Raster Content (MRC) mask layer. Setting bit 110 to "1" indicates that the called terminal does have the capability to accept up to 600 pels/25.4 mm × 600 lines/25.4 mm resolutions for colour/gray-scale images and MRC mask layer. The acceptable resolution values are determined by the DIS resolution bit settings. Bit 110 is valid only when bits 68 and 105 (600 pels/25.4 mm × 600 lines/25.4 mm) are set to "1". In a DCS frame, setting bit 110 to 0 indicates that the calling terminal does not use 600 pels/25.4 mm × 600 lines/25.4 mm resolutions for colour/gray-scale images and mask layer. Setting bit 110 to "1" indicates that the calling terminal uses 600 pels/25.4 mm × 600 lines/25.4 mm resolutions for colour/gray-scale images and MRC mask layer. Bit 110 is valid only when bits 36 or 68 and 105 (600 pels/25.4 mm × 600 lines/25.4 mm) are set to "1".

NOTE 65 – In a DIS/DTC frame, setting bit 111 to "0" indicates that the called terminal does not have the capability to accept 1200 pels/25.4 mm × 1200 lines/25.4 mm resolutions for colour/gray-scale images or T.44 Mixed Raster Content (MRC) mask layer. Setting bit 111 to "1" indicates that the called terminal does have the capability to accept up to 1200 pels/25.4 mm × 1200 lines/25.4 mm resolutions for colour/gray-scale images and MRC mask layer. The acceptable resolution values are determined by the DIS resolution bit settings. Bit 111 is valid only when bits 68 and 106 (1200 pels/25.4 mm × 1200 lines/25.4 mm) are set to "1". In a DCS frame, setting bit 111 to "0" indicates that the calling terminal does not use 1200 pels/25.4 mm × 1200 lines/25.4 mm resolutions for colour/gray-scale images and mask layer. Setting bit 111 to "1" indicates that the calling terminal uses 1200 pels/25.4 mm × 1200 lines/25.4 mm resolutions for colour/gray-scale images and MRC mask layer. Bit 111 is valid only when bits 36 or 68 and 106 (1200 pels/25.4 mm × 1200 lines/25.4 mm) are set to "1".

NOTE 66 – The receiving terminal may print the image data only on to one side even if this bit is set to "1".

NOTE 67 – Alternate mode is defined as transmission of a front page and a reverse page alternately. Continuous mode is defined as transmission all front pages and then of all reverse pages.

NOTE 68 – When bit 114 in DIS is set to "1", bit 113 shall be set to "1".

NOTE 69 – In a DIS/DTC frame, setting the value of bit 115 to "0" indicates that the called terminal does not have the capability to accept Annex H/T.4 black-and-white mixed raster content profile (MRCbw) pages. Setting the value of bit 115 to "1" and the value of bits 92 through 94 to non-zero (>0) indicates that the called terminal does have the capability to accept MRCbw pages. The value of bits 92 through 94 determines the highest MRCbw mode supported. Interpretation of the values of bits 92 through 94 is defined in Note 50. In the DCS frame, bit 115 shall be set to "0" and the value of bits 92 through 94 shall determine the MRC modes as defined in Note 50.

NOTE 70 – SharedDataMemory is the memory used by a decoder to store data that is typically used more than once in the decoding of a data stream. In a DIS/DTC frame, setting the value of bits 117 through 118 to "0" indicates that the called terminal does not have SharedDataMemory capacity. Setting the value of bits 117 through 118 to non-zero (>0) indicates that the called terminal does have SharedDataMemory capacity. In a DCS frame, setting the value of bits 117 through 118 to "0" indicates that the data stream does not require use of SharedDataMemory. Setting the value of bits 117 through 118 to non-zero (>0) indicates that the data stream does require use of SharedDataMemory. Each value of the three non-zero values of bits 117 through 118 represents a different level of receiver SharedDataMemory capacity or SharedDataMemory required in decoding the data stream.

NOTE 71 – Bit 4 set to "1" indicates 3rd Generation Mobile Network Access to the GSTN Connection. Bit 4 set to "0" conveys no information about the type of connection.

NOTE 72 – Bit 121 can only be set in the communication through the T.38 gateway to cope with delay of network.

NOTE 73 – T.x timer (12 ± 1 s) should be used after emitting RNR or TNR; however, after receiving PPS signal in ECM mode, T.5 timer should be used.

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NOTE 74 – For resolutions greater than 200 lines/25.4 mm, 4.2.1.1/T.4 specifies the use of specific K factors for each standardized vertical resolution. To ensure backward compatibility with earlier versions of ITU-T Rec. T.4, bit 122 indicates when such K factors are being used.

NOTE 75 – This bit should be set to "1" if the fax device is an Internet-Aware Fax Device as defined in ITU-T Rec. T.38 and if it is not affected by the data signal rate indicated by the DIS and DTC signals when communicating with another Internet-Aware Fax Device operating in T.38 mode. This bit shall not be used in the GSTN mode.

NOTE 76 – This bit should be set to "1" if the fax device elects to operate in an Internet-Aware Fax mode as defined in ITU-T Rec. T.38 in response to a device which has set the related DIS bit to "1".

NOTE 77 – When this bit is set to "1", the data signal rate of the modem (bits 11-14) should be set to "0".

NOTE 78 – In a DIS/DTC frame, bit 116 is valid only when:

- 1) bit 68 is set to "1" (i.e., JPEG);
- 2) the value of bits 92 through 94 is set to "4" or greater (i.e., unconstrained colour T.44 "Mixed Raster Content (MRC)" Mode 4 is available); and
- 3) the value of bits 124 through 126 is set to 2 or 4 (i.e., JBIG2 Profile 2 is available).

The value of bits 117 through 118 is typically non-zero (i.e., SharedDataMemory is available for symbol dictionaries). In a DCS frame, bit 116 is valid only when:

- 1) the value of bits 92 through 94 is set to "4" or greater (i.e., unconstrained colour MRC Mode 4 is being used);
- 2) the value of bits 124 through 126 is set to 2 (i.e., JBIG2 Profile 2 is being used); and
- 3) the value of bits 117 through 118 is typically non-zero (i.e., the data stream requires SharedDataMemory for storage of symbol dictionaries).

NOTE 79 – In a DIS/DTC frame, setting the value of bits 124 through 126 to "0" indicates that the called terminal does not have the capability to accept T.89 profiles of JBIG2 (ITU-T Rec. T.88). Setting the value of bits 124 through 126 to non-zero (>0) indicates that the called terminal does have the capability to accept JBIG2 encoded pages. Each of the non-zero values of bits 124 through 126 represents a different level of JBIG2 profile support. Support for Profile 1 is mandatory for all JBIG2 implementations. In other words, implementations of profile(s) greater than Profile 1 will also include support for Profile 1, although the Profile 1 bit is not activated. Interpretation of the profiles is defined in ITU-T Rec. T.89 (Application Profiles for ITU-T Rec. T.88). Bits 124 through 126 are valid only when bits 92 through 94 comprise a value equal or greater than "4" (i.e., ITU-T Rec. T.44 or ITU-T Annex H/T.4 "Black-and-White Mixed Raster Content Profile (MRCbw)" provision and Mode 4 or greater of each is available). The value of bits 117 through 118 is typically non-zero (i.e., >0). In a DCS frame, setting the value of bits 124 through 126 to "0" indicates that the calling terminal does not transmit JBIG2 encoded pages. Setting the value of bits 124 through 126 to non-zero (i.e., >0) indicates that the calling terminal transmits JBIG2 encoded pages. The non-zero value of bits 124 through 126 identifies the profile of T.89 that is used during the transmission. Bits 124 through 126 are valid only when bits 92 through 94 comprise a value equal or greater than "4". The value of bits 117 through 118 is typically non-zero (i.e., >0). The calling terminal shall not transmit a dictionary (e.g., symbol or halftone pattern dictionaries) or a collection of dictionaries that result in outstanding dictionary memory requirement (i.e., sum of all transmitted dictionaries for which a forget disposition has not been issued) greater than the capacity indicated by the value of DIS/DTC bits 117 through 118.

NOTE 80 – In a DIS/DTC frame, combinations of bit 42, bit 43 and bit 97 indicate that the called terminal has higher resolution capabilities as follows:

Table 2/T.30

DIS/DTC			Resolution capabilities (pels/25.4 mm)			
			Monochrome		Colour/gray-scale	
42	43	97	300 × 300	400 × 400	300 × 300	400 × 400
0	0	0	no	no	no	no
1	0	0	yes	no	no	no
0	1	0	no	yes	no	no
1	1	0	yes	yes	no	no
0	0	1	(invalid)			
1	0	1	yes	no	yes	no
0	1	1	no	yes	no	yes
1	1	1	yes	yes	yes	yes

"yes" means that the called terminal has the corresponding capability.

"no" means that the called terminal does not have the corresponding capability.

NOTE 81 – In a DIS/DTC frame, combinations of bit 105, bit 106, bit 110 and bit 111 indicate that the called terminal has higher resolution capabilities as follows:

DIS/DTC				Resolution capabilities (pels/25.4 mm)			
				Monochrome		Colour/gray-scale	
105	106	110	111	600 × 600	1200 × 1200	600 × 600	1200 × 1200
0	0	0	0	no	no	no	no
1	0	0	0	yes	no	no	no
0	1	0	0	no	yes	no	no
1	1	0	0	yes	yes	no	no
0	0	1	0	(invalid)			
1	0	1	0	yes	no	yes	no
0	1	1	0	(invalid)			
1	1	1	0	yes	yes	yes	no
0	0	0	1	(invalid)			
1	0	0	1	(invalid)			
0	1	0	1	no	yes	no	yes
1	1	0	1	yes	yes	no	yes
0	0	1	1	(invalid)			
1	0	1	1	(invalid)			
0	1	1	1	(invalid)			
1	1	1	1	yes	yes	yes	yes

"yes" means that the called terminal has the corresponding capability.

"no" means that the called terminal does not have the corresponding capability.

Table 2/T.30

NOTE 82 – Annex K describes the optional continuous-tone colour and gray scale images mode (sYCC-JPEG mode) protocol. When bit 127 in DIS/DTC frame is set to "1", the called terminal has the capability to accept sYCC-JPEG mode. This is defined with complete independent in the colour space CIELAB. In addition, when bit 127 in DCS frame is set to "1", bit 27 in DCS frame should be set to "1" and bits 15, 17, 18, 19, 20, 41, 42, 43, 45, 46, 68, 69, 71, 73, 74, 75, 76, 77, 97, 98, 105, 106, 107, 108, 109, 110 and 111 in DCS frame should be "Don't care", i.e., they should be set to "0". In the case of transmission of multiple images, a post message signal PPS-MPS between pages, PPS-NULL between partial pages and PPS-EOP following the last page should be sent from the calling terminal to the called terminal.

NOTE 83 –This bit defines the available colour space, when bit 92, 93 or 94 is set to "1".

Available colour space for all combinations of bits 92, 93, 94 and 119 are shown in the following table.

It should be noted that terminals which conform to the 2003 and earlier versions of this Recommendation will send LAB with "1" in bit 92, 93 or 94 even if bit 119 is set to "1".

Available colour space for DIS/DTC bits 92, 93, 94 and 119

Bit				Mode of T.44 and available colour space	
92	93	94	119	Mode of T.44	Available colour space
0	0	0	x	Not available	–
1	0	0	0	Mode 1	LAB only
1	0	0	1	Mode 1	YCC only
x	1	x	0	Mode 2 or higher	LAB only
x	x	1			
x	1	x	1	Mode 2 or higher	LAB and YCC
x	x	1			

x: 0 or 1

Colour space for DCS bits 92, 93, 94 and 119

Bit				Mode of T.44 and colour space	
92	93	94	119	Mode of T.44	Colour space
0	0	0	x*	Not available	–
1	0	0	0	Mode 1	LAB
1	0	0	1	Mode 1	YCC
x	1	x	0	Mode 2 or higher	LAB
x	x	1			
x	1	x	1	Mode 2 or higher	YCC or mixing of YCC and LAB
x	x	1			

x: 0 or 1

5.3.6.2.4 CSI coding format

The facsimile information field of the CSI signal shall be the international telephone number including the "+" character, the telephone country code, area code and subscriber number. This field shall consist of 20 numeric digits coded as shown in Table 3 but excluding the "*" and "#" characters. The least significant bit of the least significant digit shall be the first bit transmitted.

5.3.6.2.5 CIG coding format

The facsimile information field of the CIG signal shall be the international telephone number including the "+" character, telephone country code, area code and subscriber number. This field shall consist of 20 numeric digits coded as shown in Table 3 but excluding the "*" and "#" characters. The least significant bit of the least significant digit shall be the first bit transmitted.

5.3.6.2.6 TSI coding format

The facsimile information field of the TSI signal shall be the international telephone number including the "+" character, telephone country code, area code and subscriber number. This field shall consist of 20 numeric digits coded as shown in Table 3 but excluding the "*" and "#" characters. The least significant bit of the least significant digit shall be the first bit transmitted.

5.3.6.2.7 Non-standard capabilities (NSF, NSC, NSS)

When a non-standard capabilities FCF is utilized, it must be immediately followed by an FIF. This information field will consist of at least two octets. The first octet will contain an ITU-T country code (see Note below). Additional information could then be transmitted within the FIF field. This information is not specified and can be used to describe non-standard features, etc.

NOTE – The procedure for obtaining a registered ITU-T code is given in ITU-T Rec. T.35.

The country code shall be mapped to the FIF by mapping the most significant bit of the non-standard capabilities information to the most significant bit of the FIF. The order in which the bits are transmitted is from the most to the least significant bit (bit 8 to bit 1).

Note that some existing terminals may perform the bit mapping in the wrong order (bit 1 to bit 8). This may result in these terminals masquerading as a terminal with a different country code, possibly causing erroneous operation.

5.3.6.2.8 PWD coding format

The facsimile information field of the PWD signal shall consist of 20 numeric digits coded as shown in Table 3 but excluding the "+" character. The least significant bit of the least significant digit shall be the first bit transmitted. The unused octets in the information field shall be filled with the "space" character and the information should be right justified.

5.3.6.2.9 SEP coding format

The facsimile information field of the SEP signal shall consist of 20 numeric digits coded as shown in Table 3 but excluding the "+" character. The least significant bit of the least significant digit shall be the first bit transmitted. The unused octets in the information field shall be filled with the "space" character and the information should be right justified.

5.3.6.2.10 SUB coding format

The facsimile information field of the SUB signal shall consist of 20 numeric digits coded as shown in Table 3 but excluding the "+" character. The least significant bit of the least significant digit shall be the first bit transmitted. The unused octets in the information field shall be filled with the "space" character and the information should be right justified.

5.3.6.2.11 SID coding format

The facsimile information field of the SID signal shall consist of 20 numeric digits coded as shown in Table 3 but excluding the "+" character. The least significant bit of the least significant digit shall be the first bit transmitted. The unused octets in the information field shall be filled with the "space" character and the information should be right justified.

Table 3/T.30

Digit	MSB (FB)	Bits	LSB
+	0	010101	1
0	0	011000	0
1	0	011000	1
2	0	011001	0
3	0	011001	1
4	0	011010	0
5	0	011010	1
6	0	011011	0
7	0	011011	1
8	0	011100	0
9	0	011100	1
Space	0	010000	0
*	0	010101	0
#	0	010001	1
MSB Most Significant Bit LSB Least Significant Bit FB Fill Bit NOTE 1 – The "+" character shall not be used in the PWD/SEP/SUB signals. NOTE 2 – The "*" and "#" characters shall not be used in the CSI/CIG/TSI signals.			

5.3.6.2.12 CSA, TSA, CIA, IRA and ISP coding format

The facsimile information field of the CSA, TSA, CIA, IRA and ISP signal shall be the Internet address.

Internet address is email address, URL, TCP/IP or international telephone number.

Sequence Number	Type	Length	Internet address
-----------------	------	--------	------------------

Multiple frames are transmitted for an Internet address, if the length of the Internet address is more than 77 octets.

Format of the facsimile information field:

1st octet	Sequence number of Internet address frame
2nd octet	Type of Internet address
3rd octet	Length of Internet address
4th octet	First character of Internet address
...	
xx octet	Last character of Internet address

1st octet of the FIF indicates the sequence number of frame for multiple transmission. The sequence number for the first frame is 00 to 7F(127). MSB of 1st octet of the FIF is the extend bit where "0" indicates the last frame and "1" indicates a non-last frame.

Format of the sequence number:

Bit No.	Meaning
1	LSB of sequence number
2	Sequence number
3	Sequence number
4	Sequence number
5	Sequence number
6	Sequence number
7	MSB of sequence number
8	Extend bit

2nd octet of the FIF indicates the type of Internet address. The attribute indicates the type of email address, URL, TCP/IP V4 and International telephone number.

- 1) Email address: *use of email address in ITU-T Rec. T.38 is for further study.*
- 2) URL: *for further study.*
- 3) TCP/IP V4 and V6: *for further study.*
- 4) International telephone number: including the "+" character, telephone country code, area code and subscriber number.

The format of the type of Internet address is shown below.

Bit No.	Meaning
1	Type of Internet address
2	Type of Internet address
3	Type of Internet address
4	Type of Internet address
5	Reserved – set to "0"
6	Reserved – set to "0"
7	Reserved – set to "0"
8	Reserved – set to "0"

The permitted setting of bits 1-4 is shown below.

Bit 1	Bit 2	Bit 3	Bit 4	Internet address type
0	0	0	0	Reserved – set to "0"
1	0	0	0	Reserved for email address
0	1	0	0	Reserved for Uniform Resource Locator address
1	1	0	0	Reserved for TCP/IP Version 4 address
0	0	1	0	Reserved for TCP/IP Version 6 address
1	0	1	0	International telephone number
0	1	1	0	Reserved – set to "0"
1	1	1	0	Reserved
X	X	X	1	Reserved

3rd octet of the FIF indicates the length of Internet address in the frame. MSB of 3rd octet of the FIF is extended bit. Extended bit is used to indicate when the Internet address is divided into multiple frames. "0" indicates the last frame of the Internet address and "1" indicates a non-last frame of the Internet address.

The format of the length of Internet address is shown below.

Bit No.	Meaning
1	LSB of the length of Internet address
2	The length of Internet address
3	The length of Internet address
4	The length of Internet address
5	The length of Internet address
6	The length of Internet address
7	MSB of the length of Internet address
8	Extend bit

4th octet of the FIF is the first character of Internet address.

The bit transmission sequence is LSB of first byte of email address. The least significant bit of the first character of Internet address shall be the first bit transmitted.

xx octet of the FIF is the last character of Internet address.

"xx" must be no more than 80.

5.3.6.2.13 FNV coding format

The structure of the FIF for the FNV signal is as follows:

Reason Octets	Frame Number Octet	Diagnostic Information Octets
---------------	--------------------	-------------------------------

At least one reason octet is required in the FIF of the FNV signal. The other octets are optional, but a frame number octet is required if any of the optional diagnostic information octets are presented. Use of the optional octets is application-dependent. Terminals which implement the FNV signal must be able to receive these octets but are not required to process or respond to them.

Format for reason octets

The first octet is known as a reason octet and is used to identify cases where the contents of the Facsimile Information Field (FIF) for the specified signals are not valid. The values which apply for this octet are shown in the table below. A bit setting of "0" indicates "OK" and a bit setting of "1" indicates "invalid". Bit 8 is an extend bit, which shall be set to "1" if there are additional reason octets in the FIF. If the extend bit is set to "0", there are no additional reason octets.

Bit No.	Meaning
1	Incorrect password (PWD)
2	Selective polling reference (SEP) not known
3	Subaddress (SUB) not known
4	Sender identity (SID) not known
5	Secure fax error
6	Transmitting Subscriber Identification (TSI) not accepted
7	Polled Subaddress (PSA) not known
8	Extend Bit – default "0"; set to "1" if extension used
9	BFT Negotiations Request not accepted
10	Internet Routing Address (IRA) not known
11	Internet Selective Polling address (ISP) not known
12	Reserved – set to "0"
13	Reserved – set to "0"
14	Reserved – set to "0"
15	Reserved – set to "0"
16	Extend Bit – default "0"
NOTE – As additional reason octets are defined, they shall have a bit structure which is consistent with the first reason octet. The first seven bits shall identify reasons (or be reserved) and the eighth bit is an extend bit for reason octets.	

Format for frame number of FNV

This is an eight-bit binary number. The frame number 0-255 (maximum number is 255) is used to identify the sequence number of an FNV frame. The frame 0 is the first frame to be transmitted in a series of FNV frames. The least significant bit is transmitted first.

Format for diagnostic information octets of FNV

The diagnostic information for one or more signals may optionally be presented. The diagnostic information for each signal is presented in a series of octets using a type, length, value encoding. The order of transmission for the diagnostic information octets shall be left to right as printed and the least significant bit (right-most) shall be the first one transmitted, except as noted (see rules for value octets below).

The format for the diagnostic information for each signal is as follows:

Type	Length	Value – Invalid FIF content or other diagnostic information (variable number of octets)
------	--------	---

Type – Specified based on reversing the FCF (Facsimile Control Field) of the signal or another unique designation. One octet identifiers are normally used, but an extension method is available. The types are defined as follows:

Type	Description
1100 0001	Incorrect password (PWD)
1010 0001	Selective polling reference (SEP) not known
1100 001X	Subaddress (SUB) not known
1010 001X	Sender identify (SID) not known
0000 1000	Secure fax error
0100 001X	Transmitting subscriber identification (TSI) not accepted
0110 0001	Polled Subaddress not known
NOTE – X is as defined in 5.3.6.1.	

Length – Number of octets in the value to follow. One octet is normally used, but an extension method is available.

Value – Contains the portion of the FIF which was invalid for the signal type or other diagnostic information. For cases where all or a portion of an unaccepted FIF is being returned, the data shall be presented in the same bit and octet order as originally transmitted.

If diagnostic information is available for more than one signal, the "type" octet for the second signal will immediately follow the last "value" octet for the prior signal. In a similar manner, all of the diagnostic information for all signals shall be presented in the FIF of the FNV until all diagnostic information has been transmitted. In cases where the amount of diagnostic information to be transmitted exceeds the limits for a single T.30 frame, the remaining diagnostic information shall be placed in additional FNV frames and the frame number will be incremented by 1 for each new frame. For such additional frames, the contents of the reason octets shall be identical to the first FNV frame and the content of the diagnostic information octets shall continue from the previous frame.

Syntax of FNV facsimile information field

The detailed syntax of the FNV FIF is presented below in Backus-Naur Form (BNF). The symbols used in the BNF are defined in H.6.1.4.5.

```

<bit> ::= <0> | <1>
<octet> ::= <bit><bit><bit><bit><bit><bit><bit><bit>
<8_bit_tag> ::= <octet>
<extend_octet> ::= {<1><1><1><1><1><1><1><1>}
<FNV_type> ::= <8_bit_tag>|<extend octet><8_bit_tag><8_bit_tag>
<parameter_value> ::= <octet>{<octet>}
<count_extend_octet> ::= <0><0><0><0><0><0><0><0>
<parameter_length> ::= <octet>|<count_extend_octet><octet><octet>
<Diagnostic_Information> ::= {<FNV_type><parameter_length><parameter_value>}
<frame_number> ::= <octet>
<FNV_Reason_Octets> ::= <octet>{<octet>}
<FIF_of_FNV> ::= <FNV_Reason_Octets>[<frame_number><Diagnostic_Information>]

```

Coding examples for FNV facsimile information fields

Case A)

Password is invalid and no diagnostic information is sent.

	Reason Octet 1
Printed order	10000000
	b ₁ b ₈
Transmit order	10000000
	b ₁ b ₈

Case B)

Password is invalid and diagnostic information is sent.

The example of the password is "123456789"

	Reason Octet 1	Frame number	Type	Length	Value (ex. Password)							
Printed order	10000000	00000000	11000001	00010100	20	20	...	31	32	...	38	39
		b ₇ b ₀										
Transmit order	10000000	00000000	11000001	00101000	39	38	...	31	20	...	20	20
	b ₁ b ₈	b ₀ b ₇										

00000100

Transmit bit order

Case C)

New error bits are defined in the second reason octet.

An error occurs in bit 1 of the second reason octet and diagnostic information is not sent.

	Reason Octet 1	Reason Octet 2
Printed order	00000001	10000000
	b ₁ b ₈	b ₉ b ₁₆
Transmit order	00000001	10000000

Case D)

A new error bit is defined in the second reason octet.

An error occurs in bit 1 of the second reason octet and diagnostic information is sent for a case where the FIF of the invalid signal is being returned.

	Reason Octet 1	Reason Octet 2	Frame number		Type	Length	Value
Printed order	00000001	10000000	00000000		FCF (reverse order)	length	Return of FIF (reverse order)
b ₇ b ₀							
Transmit order	00000001	10000000	00000000		FCF (normal order)	length	Return of FIF (normal order)
b ₁ b ₈ b ₉ b ₁₆ b ₀ b ₇							

Case E)

New error bits are defined in the second reason octet. A portion of the Subaddress is invalid (see bit 3) and an error is indicated in bit 9 or the second reason octet. Diagnostic Information is included for both errors. The example of the subaddress is "SSSSSSSSSS1002#2002" and only extension 1002 is being rejected. A portion of the value of the Diagnostic Information for the second error extends over the frame boundary, so a second frame is transmitted with the continuation of the value. The diagnostic information for the second error does not include the return of a previous FIF, so the general rule for transmission bit order (LSB or right-most bit first) applies.

First frame

	Reason Octet 1	Reason Octet 2	Frame number	Type 1 (SUB)	Length (4)	Value (Returned Portion of FIF)			
Printed order	00100001	10000000	00000000	11000011	00000100	31	30	30	32
b ₇ b ₀								Length of 1st block	
Transmit order	00100001	10000000	00000000	11000011	00100000	32	30	30	31
b ₁ b ₈ b ₉ b ₁₆ b ₀ b ₇								10001100	
								Transmit bit order	

First frame (continued)

	Type 2	Length (128)	value
Printed order	Type	10000000	value
Transmit order	Type (LSB order)	00000001	value (LSB order)

Second frame

	Reason Octet 1	Reason Octet 2	Frame number (2)	value (continuation)
Printed order	00100001	10000000	00000001	value (continued)
			b ₇ b ₀	
Transmit order	00100001	10000000	10000000	value (LSB first)
	b ₁ b ₈	b ₉ b ₁₆	b ₀ b ₇	

5.3.6.2.14 PSA coding format

The facsimile information field of the PSA signal shall consist of 20 numeric digits coded as shown in Table 3 but excluding the "+" character. The least significant bit of the least significant digit shall be the first bit transmitted. The unused octets in the information field shall be filled with the "space" character and the information should be right justified.

5.3.7 Frame Check Sequences (FCSs)

The FCS shall be a 16-bit sequence. It shall be the 1s complement of the sum (modulo 2) of:

- 1) remainder of $x^k (x^{15} + x^{14} + x^{13} + \dots + x^2 + x + 1)$ divided (modulo 2) by the generator polynomial $x^{16} + x^{12} + x^5 + 1$, where k is the number of bits in the frame existing between, but not including, the final bit of the opening flag and the first bit of the FCS, excluding bits inserted for transparency; and
- 2) the remainder after multiplication by x^{16} and then division (modulo 2) by the generator polynomial $x^{16} + x^{12} + x^5 + 1$, of the content of the frame, existing between, but not including, the final bit of the opening flag and the first bit of the FCS, excluding bits inserted for transparency.

As a typical implementation, at the transmitter, the initial remainder of the division is preset to all 1s and is then modified by division by the generator polynomial (as described above) on the address, control and information fields; the 1s complement of the resulting remainder is transmitted as the 16-bit FCS sequence.

At the receiver, the initial remainder is preset to all 1s and the serial incoming protected bits and the FCS when divided by the generator polynomial will result in a remainder of 0001110100001111 (x^{15} through x^0 , respectively) in the absence of transmission errors.

The FCS shall be transmitted to the line commencing with the coefficient of the highest term.

5.4 Binary coded signalling implementation requirements

5.4.1 Commands and responses

Whereas 5.2 defines a flow diagram to give an accurate example of the typical use of the binary coded procedures, these procedures are defined specifically in terms of the actions that occur on receipt of commands by the receiving terminal (see 5.3).

A response must be sent, and only sent, upon detecting a valid command. Upon receiving a valid response, a new command must be issued within 3 s.

5.4.1.1 Optional command and response frames

If optional frames (e.g., NSF or NSF CSI) are sent, they must directly precede any mandatory command/response frame which is sent. In this case, bit 5 of the control field is "0" for the optional frames and is "1" only for the final frame (refer to 5.3.5).

5.4.1.2 Options within standard frames

Certain optional portions of standard signals (e.g., the fifth bit of the PRI-Q signal) need not be utilized at either the transmitting terminal or the receiving terminal. However, the use of these optional portions of standard signals shall not cause erroneous operation.

5.4.2 Line control procedures and error recovery

Once the transmitting and receiving terminals have been identified, all commands are initiated by the transmitting terminal and solicit an appropriate response from the receiving terminal (see Appendix II). Furthermore, the transmission of a response is permitted only when solicited by a valid command. If the transmitting terminal does not receive an appropriate valid response within $3\text{ s} \pm 15\%$, it will repeat the command. After three unsuccessful attempts, the transmitting terminal will send the disconnect (DCN) command and terminate the call. A command or a response is not valid and should be discarded if:

- i) any of the frames, optional or mandatory, have an FCS error;
- ii) any single frame exceeds $3\text{ s} \pm 15\%$ (see Note 1);
- iii) the final frame does not have the control bit 5 set to a binary "1";
- iv) the final frame is not a recognized standard command/response frame (see Appendix II).

The delay of 3 s before retransmission of the command can be shortened by the use of the optional command repeat (CRP) response. If the transmitting terminal receives a CRP response, it may immediately retransmit the most recent command.

During the initial pre-message procedure, neither terminal has a defined role (i.e., transmitter or receiver). Therefore, the terminal transmitting the DIS command will continue to retransmit it until, according to the procedures, each terminal has identified itself and the normal line control procedures may be followed.

After receipt of a signal using the T.30 binary coded modulation system or V.27 *ter*/V.29/V.17 modulation system, the terminal must respond within the time period of 1.5 s. However, alternative procedures used by some terminals which conform to the pre-2001 version of this Recommendation may exist.

NOTE 1 – The implications of a maximum frame length of $3\text{ s} \pm 15\%$ are:

- a) no transmitted frame should exceed 2.55 s (i.e., $3\text{ s} - 15\%$);
- b) any frame which is received and is detected as greater than 3.45 s shall be discarded (i.e., $3\text{ s} + 15\%$);
- c) a frame received which is between 2.55 and 3.45 s duration may be discarded.

NOTE 2 – A terminal may discard a received DIS signal with the identical bit allocation as that terminal has issued.

5.4.3 Timing considerations

5.4.3.1 Time-outs

Time-out T0 defines the amount of time an automatic calling terminal waits for the called terminal to answer the call.

T0 begins after the dialling of the number is completed and is reset:

- a) when T0 times out; or
- b) when timer T1 is started; or
- c) if the terminal is capable of detecting any condition which indicates that the call will not be successful, when such a condition is detected.

The recommended value of T0 is $60 \pm 5\text{ s}$; however, when it is anticipated that a long call set-up time may be encountered, an alternative value of up to 120 s may be used.

NOTE – National regulations may require the use of other values for T0.

Time-out T1 defines the amount of time two terminals will continue to attempt to identify each other. T1 is 35 ± 5 s, begins upon entering phase B, and is reset upon detecting a valid signal or when T1 times out.

For operating methods 3 and 4 (see 3.1), the calling terminal starts time-out T1 upon reception of the V.21 modulation scheme.

For operating method 4 *bis* a (see 3.1), the calling terminal starts time-out T1 upon starting transmission using the V.21 modulation scheme.

Time-out T2 makes use of the tight control between commands and responses to detect the loss of command/response synchronization. T2 is 6 ± 1 s and begins when initiating a command search (e.g., the first entrance into the "command received" subroutine, reference flow diagram in 5.2). T2 is reset when an HDLC flag is received or when T2 times out.

Time-out T3 defines the amount of time a terminal will attempt to alert the local operator in response to a procedural interrupt. Failing to achieve operator intervention, the terminal will discontinue this attempt and shall issue other commands or responses. T3 is 10 ± 5 s, begins on the first detection of a procedural interrupt command/response signal (i.e., PIN/PIP or PRI-Q) and is reset when T3 times out or when the operator initiates a line request.

Time-out T5 is defined for the optional T.4 error correction mode. Time-out T5 defines the amount of time waiting for clearance of the busy condition of the receiving terminal. T5 is 60 ± 5 s and begins on the first detection of the RNR response. T5 is reset when T5 times out or the MCF or PIP response is received or when the ERR or PIN response is received in the flow control process after transmitting the EOR command. If the timer T5 has expired, the DCN command is transmitted for call release.

The time-outs for the optional mode of operation over public digital networks are given in Annex C.

6 Use of the modulation system defined in ITU-T Rec. V.34

6.1 Procedures

The use of Error Correction Mode (ECM) is mandatory for all facsimile messages using the V.34 half-duplex and duplex modulation system. The procedures in Annex A shall be followed except as indicated in Annexes C and F. A Group 3 facsimile terminal which supports the duplex mode is required also to support the half-duplex mode. The start-up procedures defined in ITU-T Rec. V.8 are common to both half-duplex and duplex modes of ITU-T Rec. V.34, the terminal shall follow the procedures defined in ITU-T Rec. V.8, except as noted here.

6.1.1 An answering V.34 capable facsimile terminal shall transmit ANSam until a valid CM response is received or until an ANSam time-out (2.6 to 4.0 s) has expired.

6.1.2 A calling V.34 capable terminal shall respond to the detection of ANSam by transmitting a call menu (CM). The direction of facsimile transmission shall be determined by the call terminal selecting one of the V.8 call function codes shown in Table 4.

Table 4/T.30 – The call function category

Start	b ₀	b ₁	b ₂	b ₃	b ₄	b ₅	b ₆	b ₇	Stop	Octet – "callf0"
0	1	0	0	0	0	0	0	1	1	Transmit facsimile from call terminal
0	1	0	0	0	0	1	0	1	1	Receive facsimile at call terminal
NOTE – The same codepoints are used for duplex and half-duplex modes.										

6.1.3 After receiving a valid CM, the terminal shall follow the procedures described in ITU-T Rec. V.8. However, if the ANSam time-out expires, the answer terminal shall proceed with the binary coded signalling procedures described in clause 5 using the basic 300 bit/s modulation. Bit 6 of the DIS frame shall be set to "1".

6.1.4 If a call terminal, while in the 300 bit/s mode receives a DIS frame with bit 6 set to "1", it may reinitiate the V.8 procedures by transmitting a CI signal. When an answer terminal, expecting a response to a DIS frame, detects a CI signal, it shall enter the V.8 mode by resending the answer tone ANSam.

6.1.5 If the CM/JM exchange indicates that the modulation system defined in ITU-T Rec. V.34 is available in both the calling and called terminals, then the procedures defined in Annex C shall be followed in the case of duplex operation and Annex F in the case of half-duplex operation.

6.1.6 If the CM/JM exchange indicates that the modulation system defined in ITU-T Rec. V.34 is not available in both the calling and called terminals, then the procedures defined in clause 5 shall be followed.

6.1.7 At any time during a GSTN call and while in telephony mode, the parties might verbally negotiate that they want to send a document via fax terminals. In this manual communication mode, the fax terminal which sends a document shall be defined as the call terminal and it uses the call modem procedure in ITU-T Recs V.8 and V.34. The fax terminal which receives a document shall be defined as the answer terminal and it uses the answer modem procedure in ITU-T Recs V.8 and V.34. The designation remains valid for the duration of the ensuing facsimile communication. The terminal which intends to send a document shall detect ANSam and send CM. The terminal which intends to receive a document shall enter the V.8 procedure by sending ANSam. Afterwards the call terminal and answer terminal procedures will be followed by the corresponding terminal regardless of which is the original caller.

6.2 The procedure for selecting the relevant mode is shown in Figure 11. The procedures for duplex and half-duplex operation are contained in Annexes C and F, respectively.

6.2.1 Optional codepoints are available during the V.8 procedure to select. Extended Negotiations. The procedures for selecting Extended Negotiations via V.8 are for further study.

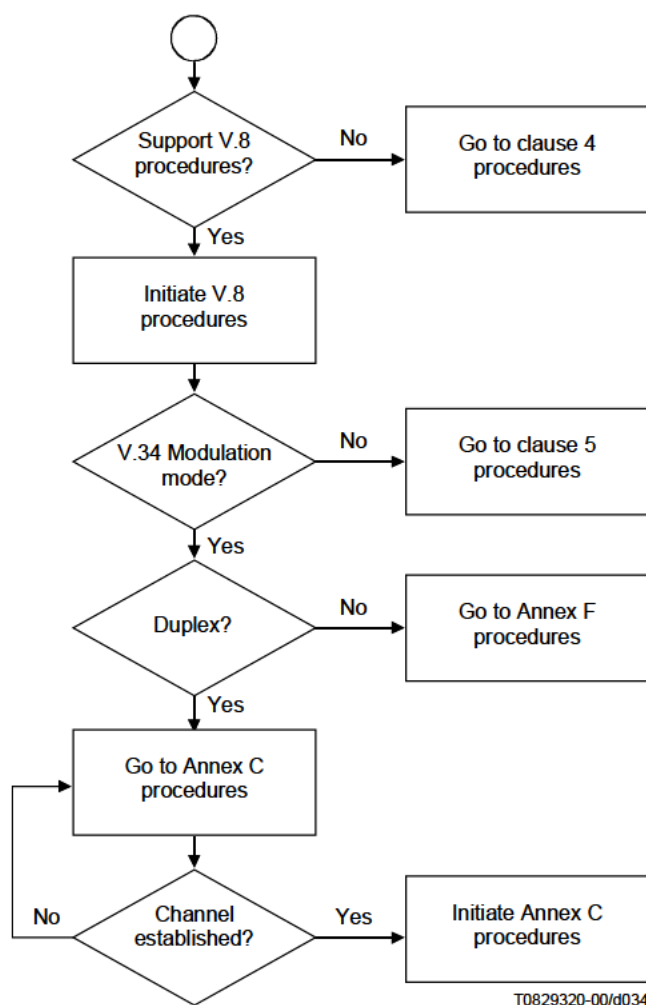


Figure 11/T.30

Annex A

Procedure for G3 document facsimile transmission in the general switched telephone network incorporating error correction

A.1 Introduction

A.1.1 This annex is intended to apply to document facsimile terminals covered by Annex A/T.4. It describes the procedures and signals to be used where terminal incorporates error correction capabilities. When existing terminals are operating in a non ITU-T manner, they shall not interfere with terminals operating in accordance with the T-series Recommendations.

A.1.2 Use of this annex is optional.

A.1.3 Outline of the error correction method

The error correction method described in this annex is based on half-duplex page selective repeat ARQ (Automatic Repeat Request) technique.

An HDLC frame structure is utilized for all binary coded facsimile message procedures.

The transmitting terminal can decide to use either 256 or 64 octets for the frame size by using DCS command. The receiving terminal must be able to receive 256 and 64 octets of frame size. The receiving terminal can express a preference for the frame size by using the DIS/DTC command.

The transmitting terminal divides the coded data specified in clause 4/T.4 into a number of frames and transmits them with each frame number.

When the previous message has not been satisfactorily received, the receiving terminal transmits PPR response to indicate that the frames specified in the associated facsimile information field are required to be retransmitted.

When PPR is received, the transmitting terminal retransmits the requested frames specified in PPR information field.

When PPR is received four times for the same block, either the EOR command is transmitted for end of retransmission or CTC (continue to correct) command is sent for continuous retransmission.

In the case of continuous retransmission, the modem speed may fall back or continue at the same speed in accordance with the decision of the transmitting terminal.

A.2 Definitions

A.2.1 The signals and definitions used in the error correction procedure are as defined in the main body of this Recommendation, unless specified otherwise.

A.2.2 Frame formats of RCP frame and FCD frame for the in-message procedure are defined in Annex A/T.4.

A.2.3 Relations between a page, blocks, partial pages and frames

One page of coded data specified in clause 4/T.4 is divided into a number of blocks. The block contains a number of frames. A partial page is defined as one transmitted block or a number of retransmitted frames.

A.2.4 Block size

The block size is defined as the maximum number of frames that can be sent by the transmitter before receiving the response.

A.3 Block size and frame size

A.3.1 For T.4 error correction mode, a transmitting terminal indicates frame size by using DCS signal.

A.3.2 The following values of frame size are applicable: 256 or 64 octets. These values of frame size do not include either FCF or frame number octet. Therefore, the total length of the HDLC information field including both the FCF and the frame number octet is as follows: 258 or 66 octets.

A.3.3 The receiving terminal must have the following conditions:

- frame size: 256 or 64 octets;
- block size: 256 frames.

A.3.4 The transmitting terminal may send the block whose size is less than 256 frames at the end of each page. This block is called a short block.

A.3.5 The frame size should not be changed during a transmission of one page. In order to change the frame size, indication of mode change should be made using PPS-EOM or EOR-EOM command at the page boundary.

A.4 Information field (see also 5.3.6)

The HDLC information fields are of variable length and contain the specific information for the control and message interchange between two facsimile terminals. In this Recommendation, it is divided into two parts: the Facsimile Control Field (FCF) and the Facsimile Information Field (FIF).

- 1) *Facsimile Control Field (FCF)* – The facsimile control field is defined to be the first 8 bits or 16 bits of the HDLC information field. FCF of 16 bits should be applied only for the optional T.4 error correction mode. This field contains the complete information regarding the type of information being exchanged and the position in the overall sequence. The bit assignments within the FCF are as follows:

Where X appears as the first bit of FCF, X will be defined as follows:

- X is set to "1" by the terminal which receives a valid DIS signal;
- X is set to "0" by the terminal which receives a valid and appropriate response to a DIS signal;
- X will remain unchanged until the terminal again enters the beginning of phase B.

- 2) *Facsimile Information Field (FIF)* – In many cases the FCF will be followed by the transmission of additional 8-bit octets to further clarify the facsimile procedure. This information for the basic binary coded system would consist of the definition of the information in DIS, DCS, DTC, CSI, CIG, TSI, NSC, NSF, NSS, CTC, PPS and PPR signals.

A.4.1 Command to receive (see also 5.3.6.1.3)

From the transmitter to the receiver.

Format: X100 XXXX

- 1) *Continue To Correct (CTC)* – This command indicates that the transmitting terminal shall continue to correct the previous message. This is a response to the 4th PPR received, and indicates that the transmitting terminal shall immediately send the requested frames specified in PPR information field.

When the transmitter receives PPR four times, the modem speed may fall back or continue the previous transmission speed using CTC command.

This command should have the FIF of 2 octets, which corresponds to bits 1-16 of DCS standard command (see Table 2). The receiving terminal uses only bits 11-14 to determine the data signalling rate.

Format: X100 1000

A.4.2 Pre-message response signals (see also 5.3.6.1.4)

From the receiver to the transmitter.

Format: X010 XXXX

- 1) *Response for Continue To Correct (CTR)* – This signal is the digital response to CTC signal, so that the receiving terminal can accept the contents included in the CTC signal.

Format: X010 0011

A.4.3 Post-message commands (see also 5.3.6.1.6)

From the transmitter to the receiver.

Format: X111 XXXX

- 1) *Partial Page Signal (PPS)* – This command indicates the end of a partial page or a complete page of facsimile information and also indicates to return to the beginning of phase B or C upon receipt of MCF.

Format: X111 1101

The frame construction of PPS command and transmission order of bits included in I1-I3 are shown in Figure A.1.

- 2) *End Of Retransmission (EOR)* – This command indicates that the transmitter decides to terminate the retransmission of error frames in the previous partial page and to transmit the next block upon receipt of ERR response.

Format: X111 0011

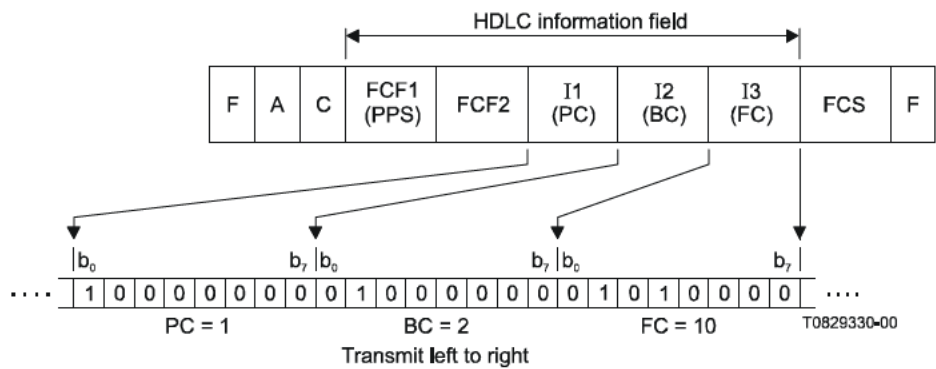
The frame construction of EOR command is shown in Figure A.2.

- 3) *Receive Ready (RR)* – This command is used to ask for the status of the receiver.

Format: X111 0110

NOTE 1 – This signal is defined for flow control.

NOTE 2 – For flow control, refer to A.5.



- FCF1 Facsimile control field 1: Extension signal for error correction (PPS)
- FCF2 Facsimile control field 2: Post-message command (NULL, MPS, EOM, EOP, EOS and PRI-Q)
- I1(PC) Information field 1: Page counter (8 bits: modulo 256)
- I2(BC) Information field 2: Block counter (8 bits: modulo 256)
- I3(FC) Information field 3: (Number of frames) – 1 in each partial page (8 bits: maximum 255)

NOTE 1 – FCF2 indicates the post-message commands in case of the T.4 error correction mode and the format of FCF2 is shown hereafter.

FCF2	Meaning
0000 0000	NULL code which indicates the partial page boundary
1111 0001	EOM in optional T.4 error correction mode
1111 0010	MPS in optional T.4 error correction mode
1111 0100	EOP in optional T.4 error correction mode
1111 1000	EOS in optional T.4 error correction mode
1111 1001	PRI-EOM in optional T.4 error correction mode
1111 1010	PRI-MPS in optional T.4 error correction mode
1111 1100	PRI-EOP in optional T.4 error correction mode

The other bit combinations are not used.

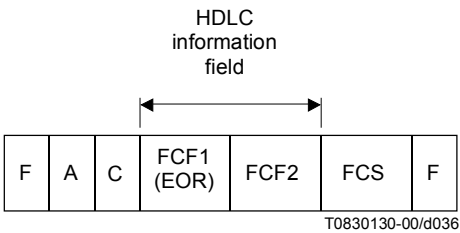
NOTE 2 – I1: Page counter shows the page sequence modulo number in each call establishment for one direction of message transfer. Page counter is started from "0" and up to "255". The page counter is reset at the start of each call establishment.

NOTE 3 – I2: Block counter shows the block sequence modulo number in each page. Block counter is started from "0" and up to "255". The block counter is reset at the start of each page.

NOTE 4 – I3: Frame counter shows the total transmitted frame number minus 1 in each partial page. (Maximum 255).

NOTE 5 – The least significant bit in I1-I3 should be transmitted first.

Figure A.1/T.30



FCF1 Facsimile control field 1: Extension signal for error correction (EOR)
FCF2 Facsimile control field 2: Post-message command (NULL, MPS, EOM, EOP and PRI-Q)

NOTE – FCF2 indicates the post-message commands in case of the T.4 error correction mode and the format of FCF2 is shown hereafter.

<u>FCF2</u>	<u>Meaning</u>
0000 0000	NULL code which indicates the partial page boundary
1111 0001	EOM in optional T.4 error correction mode
1111 0010	MPS in optional T.4 error correction mode
1111 0100	EOP in optional T.4 error correction mode
1111 1001	PRI-EOM in optional T.4 error correction mode
1111 1010	PRI-MPS in optional T.4 error correction mode
1111 1100	PRI-EOP in optional T.4 error correction mode

The other bit combinations are not used.

The signal EOR is excluded from use during file transfer, character mode and mixed mode.

Figure A.2/T.30

A.4.4 Post-message responses (see also 5.3.6.1.7)

From the receiver to the transmitter.

Format: X011 XXXX

- 1) *Partial Page Request (PPR)* – This signal indicates that the previous message has not been satisfactorily received and that the frames specified in the associated facsimile information field are required to be retransmitted.

Format: X011 1101

The facsimile information field of the PPR signal is a fixed length of 256 bits, each bit corresponds to an FCD frame, i.e., the first bit to the first frame, etc. For FCD frames which are received correctly, the corresponding bit in the PPR information field will be set to "0"; those that are received incorrectly or not received will have their bit set to "1".

If more than one PPR signal is transmitted, the bit corresponding to an FCD frame which has been received correctly must always be set to "0".

The frame construction of PPR response is shown in Figure A.3.

The process of an error correction is shown in Figure A.4.

NOTE 1 – The number of frames in a partial page is less than or equal to 256 frames. Therefore in some circumstances, there may be extra bits that do not correspond to any frames. These bits are set to "1" (see Figure A.5.)

NOTE 2 – The first bit in the FIF corresponds to the first frame (frame No. 0).

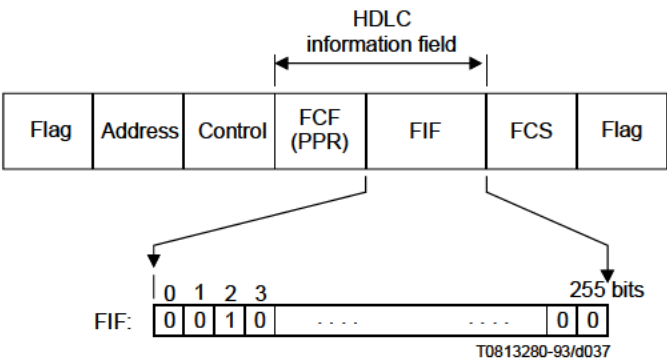


Figure A.3/T.30

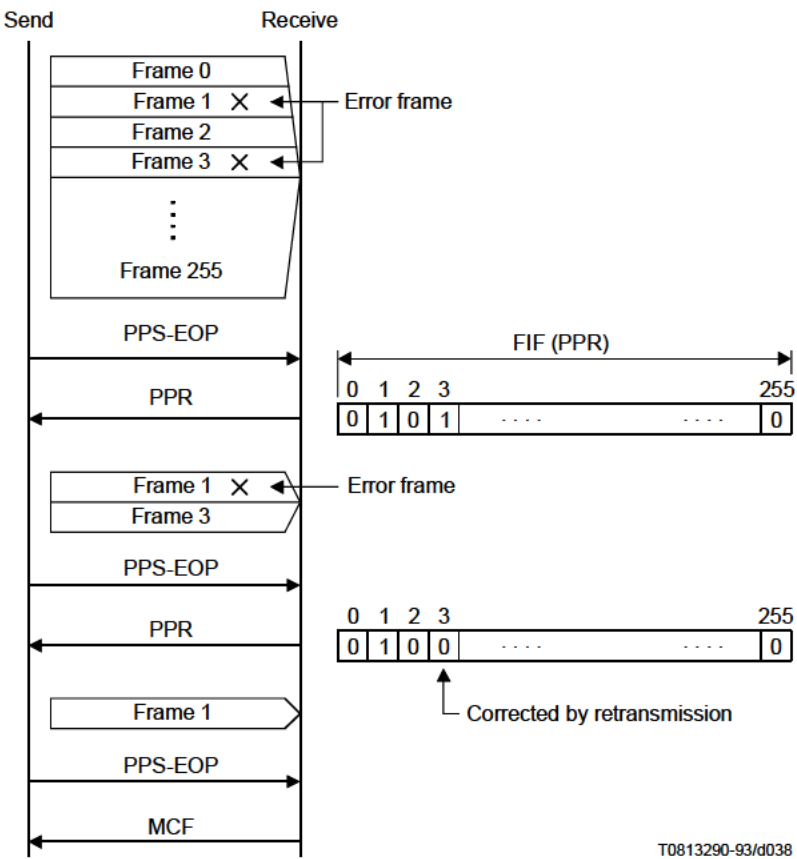


Figure A.4/T.30

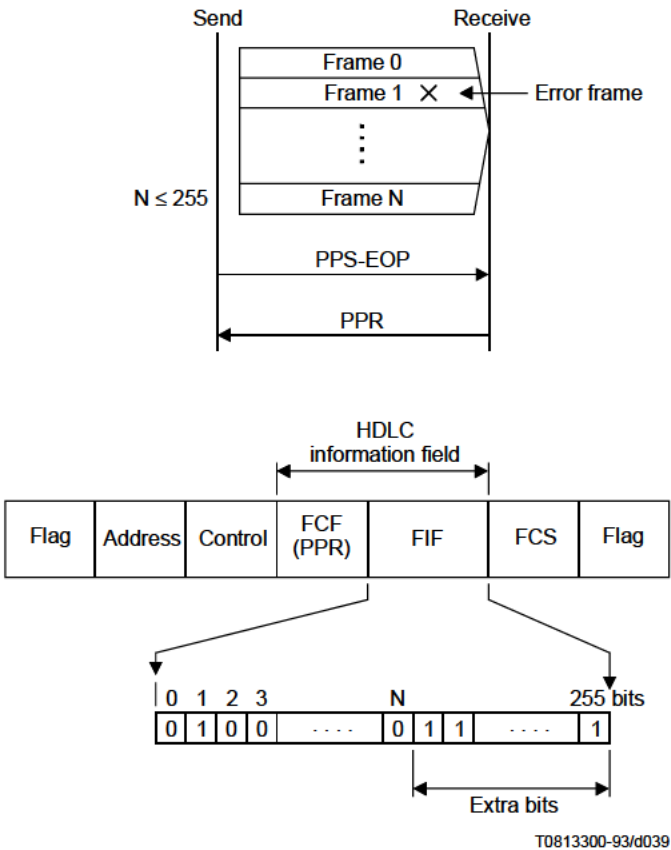


Figure A.5/T.30

- 2) *Receive Not Ready (RNR)* – This signal is used to indicate that the receiver is not ready to receive more data.
Format: X011 0111
NOTE 3 – This signal is defined for flow control.
NOTE 4 – For flow control, refer to A.5.
- 3) *Response for End of Retransmission (ERR)* – This signal is the digital response to EOR signal.
Format: X011 1000

A.5 Flow control procedure

- A.5.1** Flow control in the transmitting terminal is made by continuous flag transmission between frames or before the first frame.
- A.5.2** The maximum transmission time of flags should be less than the value of timer T1.
- A.5.3** In case of transmission on a noisy channel, a long flag sequence may be destroyed by noise. Therefore, it is recommended that the receiver implement a control procedure to discard invalid frames which are obtained from erroneous flag sequences.
- A.5.4** Flow control in the receiving terminal is made using RR/RNR signals as shown in Figure A.6.

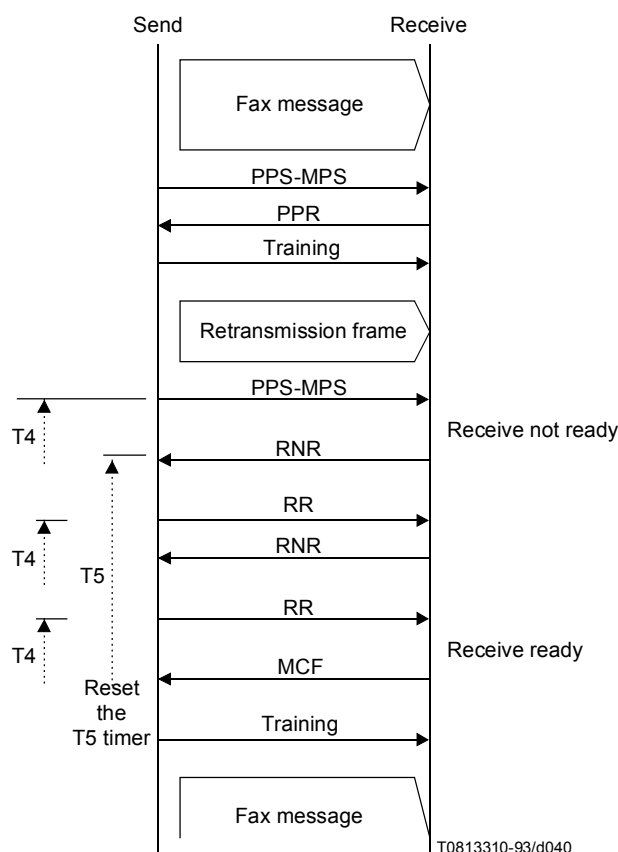


Figure A.6/T.30

A.5.4.1 Inactivity timer T5 is defined as follows:

$$T5 = 60 \text{ s} \pm 5 \text{ s.}$$

NOTE – As the use of the T5 timer reduces transmission efficiency, implementation which minimizes its effect is desirable.

A.5.4.2 The timer T5 is started at the timing of the first RNR response recognition.

A.5.4.3 If the timer T5 has expired, the transmitter sends a DCN command for call release.

A.5.4.4 If RNR response is not received correctly, an RR command is retransmitted to the receiver. After three unsuccessful attempts, the transmitter sends a DCN command for call release.

A.5.4.5 After receiving RNR response, the transmitter immediately sends an RR command until an MCF/PIP response or an ERR/PIN response is received correctly.

A.5.4.6 An MCF or ERR response indicates that the busy condition is cleared and the receiver ready to receive the data which follows the interruption.

A.6 Procedure interrupt

A.6.1 Procedure interrupt signals are not allowed at the partial page boundaries.

A.6.2 Procedure interrupt after detection or transmission of PIP and PIN signals is accomplished by using the procedure defined in the main body of this Recommendation. This procedure is outside the scope of the error correction mode specified in this annex.

A.7 Flow diagrams

The flow diagrams in 5.2 show the phase B, pre-message procedures, phase C, message procedure, phase D, post-message procedures and phase E, call release for both the transmitting and receiving terminals.

A.8 Signal sequence examples in case of error correction procedure

The examples in Figure A.7 are based on the flow diagrams and for illustrative and instructional purposes only. They should not be interpreted as establishing or limiting the protocol. The exchange of the various commands and responses is limited only by the rules specified in this Recommendation.

In the following diagrams, the dashed lines indicate transmission at the message data rate (ITU-T Recs V.27 *ter*, V.29, V.17, V.34) and (X, Y) means (page modulo number, block modulo number).

Example 1 An auto calling terminal wishing to transmit to an auto answer terminal: example of T.4 error correction.

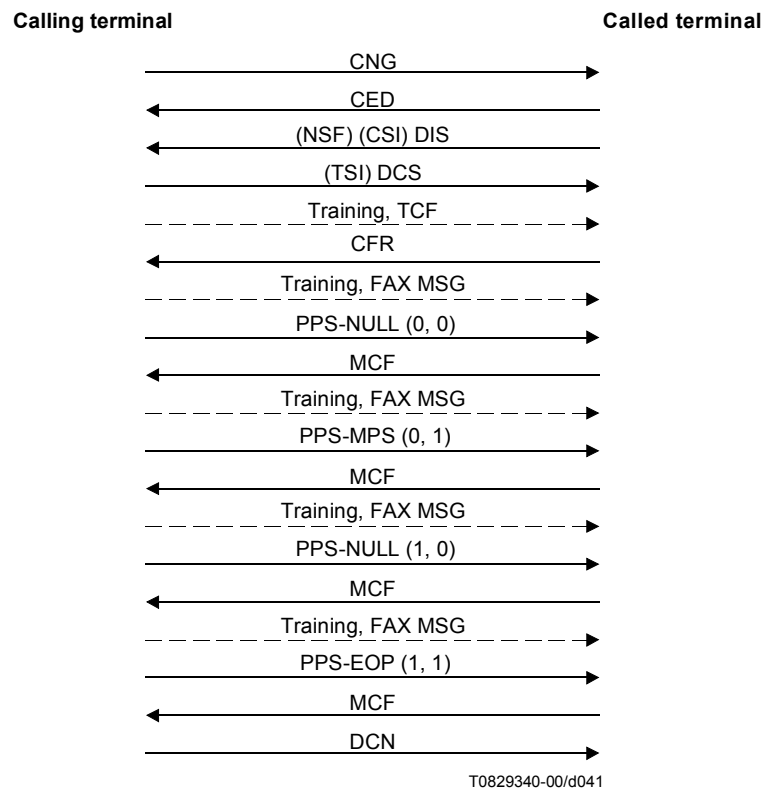


Figure A.7/T.30 (sheet 1 of 13)

Example 2 An auto calling terminal wishing to transmit to an auto answer terminal: example of PPR sequence with errors.

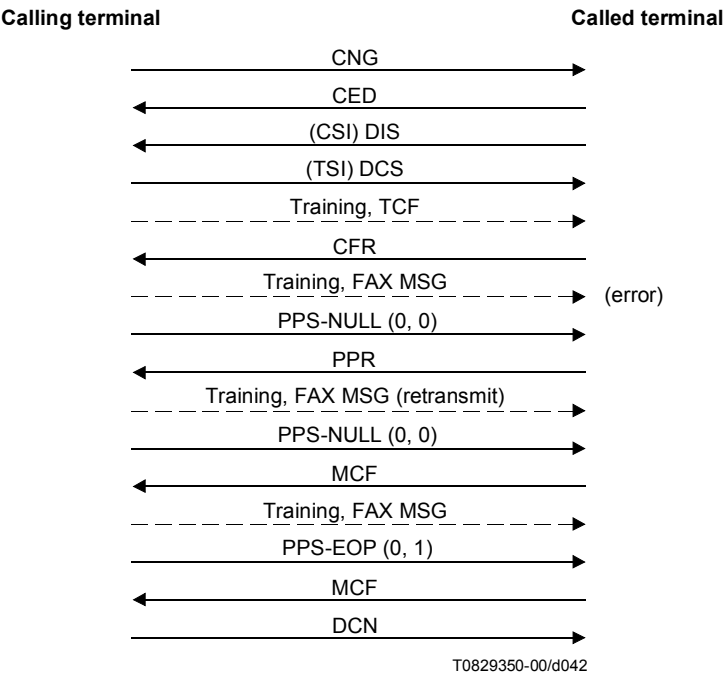


Figure A.7/T.30 (sheet 2 of 13)

Example 3 An auto calling terminal wishing to transmit to an auto answer terminal: example of post-message commands with errors.

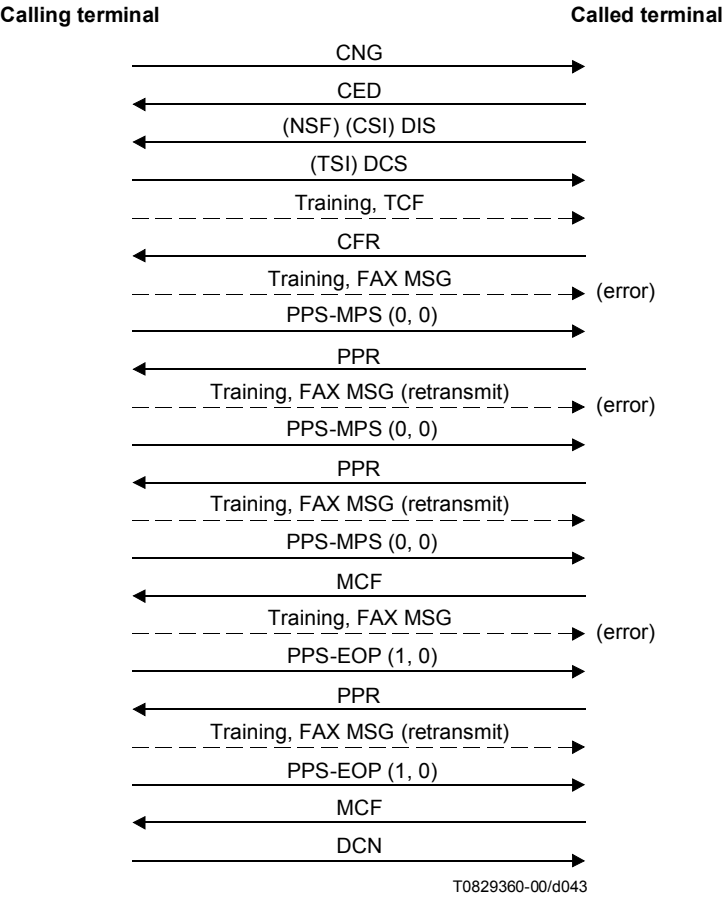


Figure A.7/T.30 (sheet 3 of 13)

Example 4 An auto calling terminal wishing to transmit to an auto answer terminal:
example of first command failure with message errors.

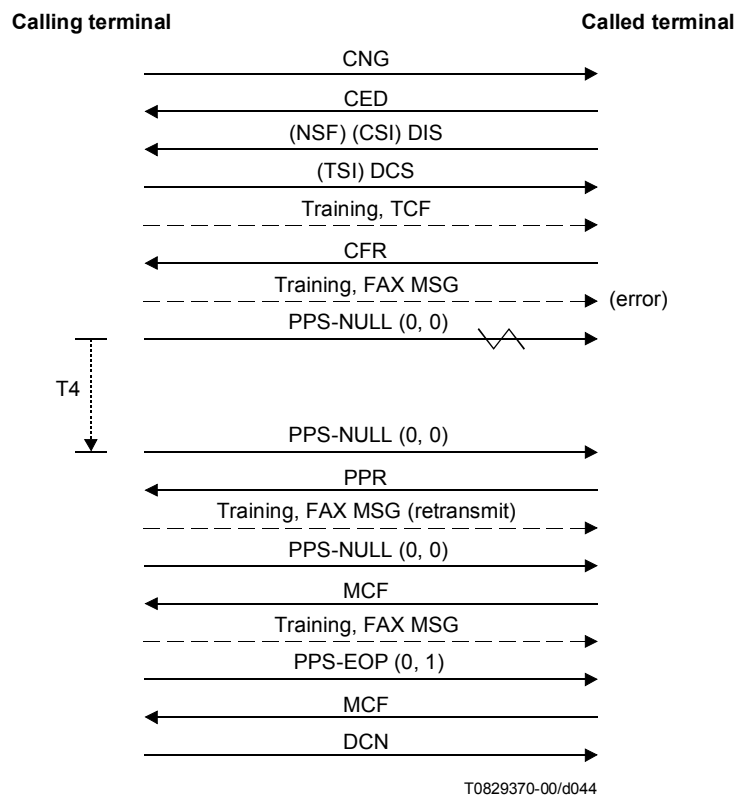


Figure A.7/T.30 (sheet 4 of 13)

Example 5 An auto calling terminal wishing to transmit to an auto answer terminal:
example of response failure with message errors.

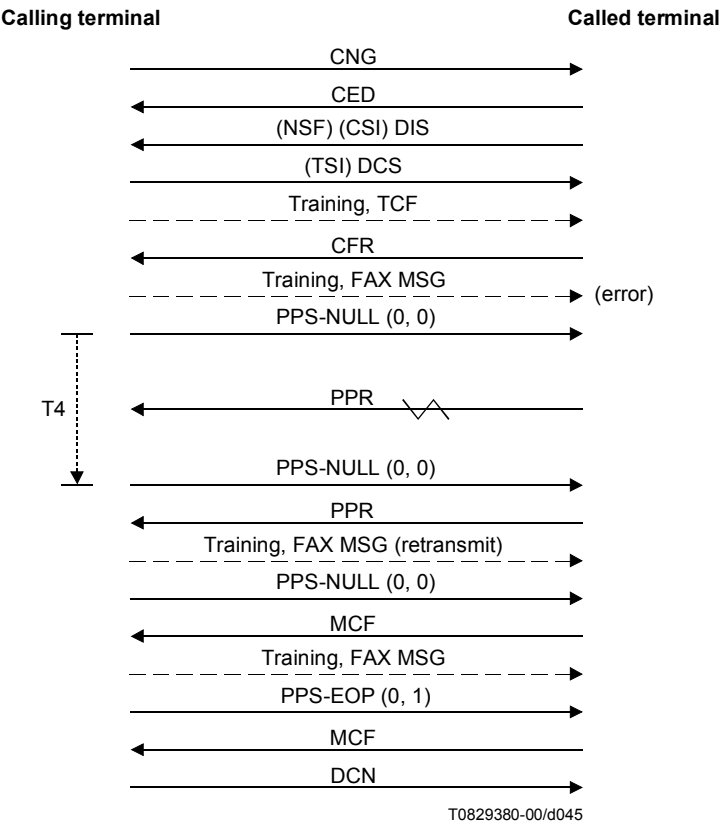


Figure A.7/T.30 (sheet 5 of 13)

Example 6 An auto calling terminal wishing to transmit to an auto answer terminal:
example of fall-back (CTC).

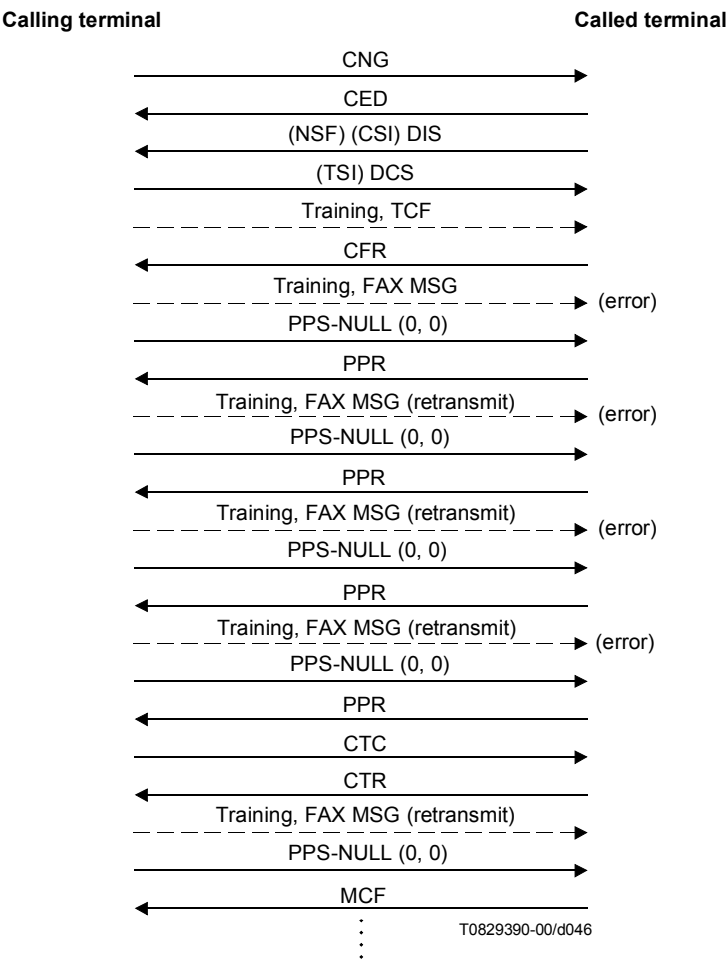


Figure A.7/T.30 (sheet 6 of 13)

Example 7 An auto calling terminal wishing to transmit to an auto answer terminal: example of flow control.

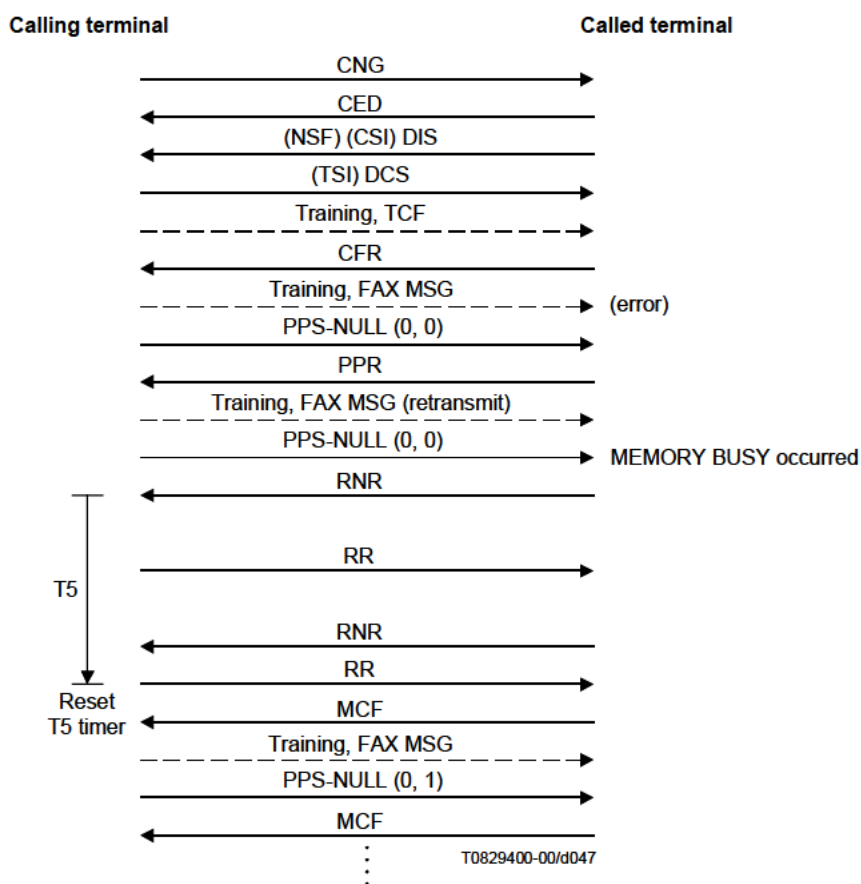


Figure A.7/T.30 (sheet 7 of 13)

Example 8 An auto calling terminal wishing to transmit to an auto answer terminal: example of T5 time-out during flow control.

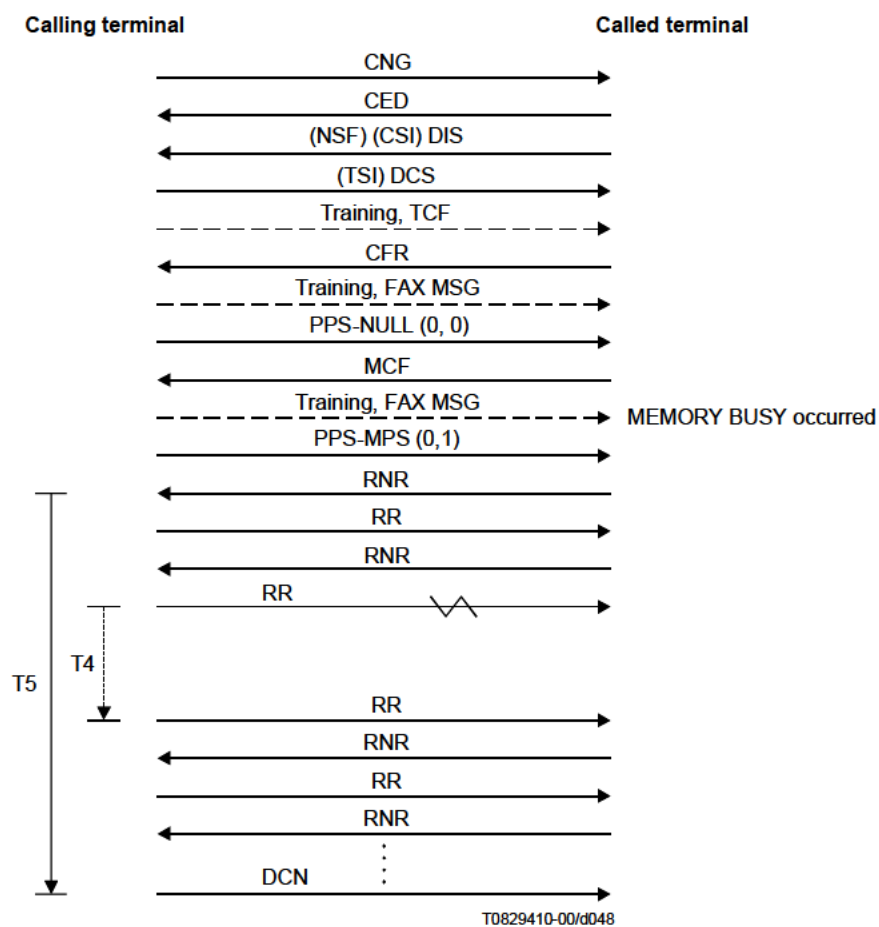


Figure A.7/T.30 (sheet 8 of 13)

Example 9 An auto calling terminal wishing to transmit to an auto answer terminal:
example of procedural interrupt.

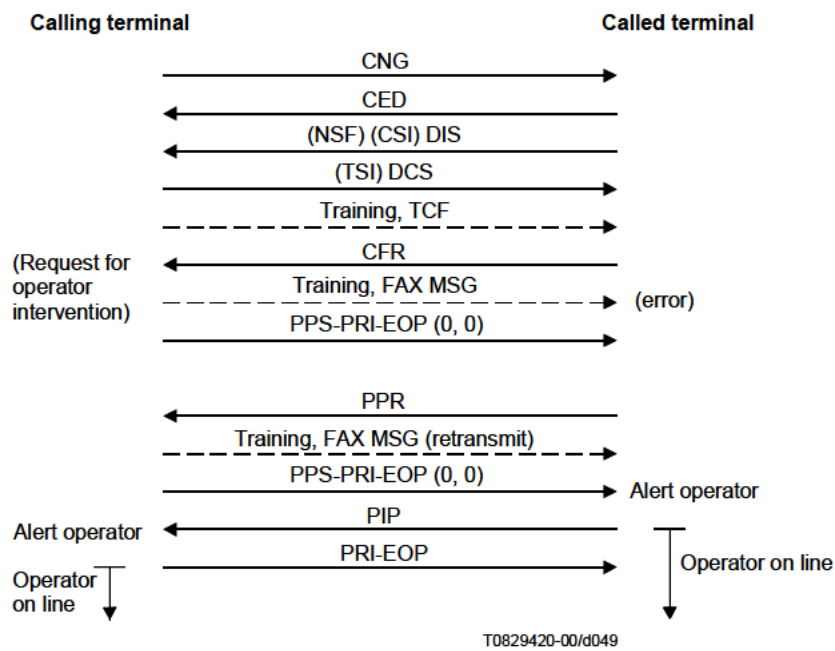


Figure A.7/T.30 (sheet 9 of 13)

Example 10 An auto calling terminal wishing to transmit to an auto answer terminal:
example of post-message response.

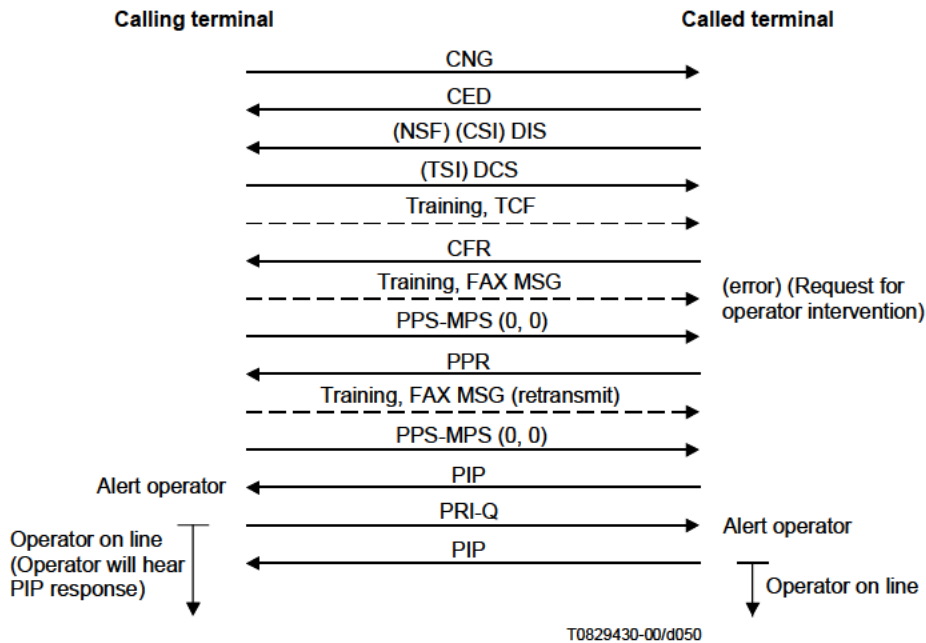


Figure A.7/T.30 (sheet 10 of 13)

Example 11 An auto calling terminal wishing to transmit to an auto answer terminal:
example of EOR (first block message was not satisfactorily
received).

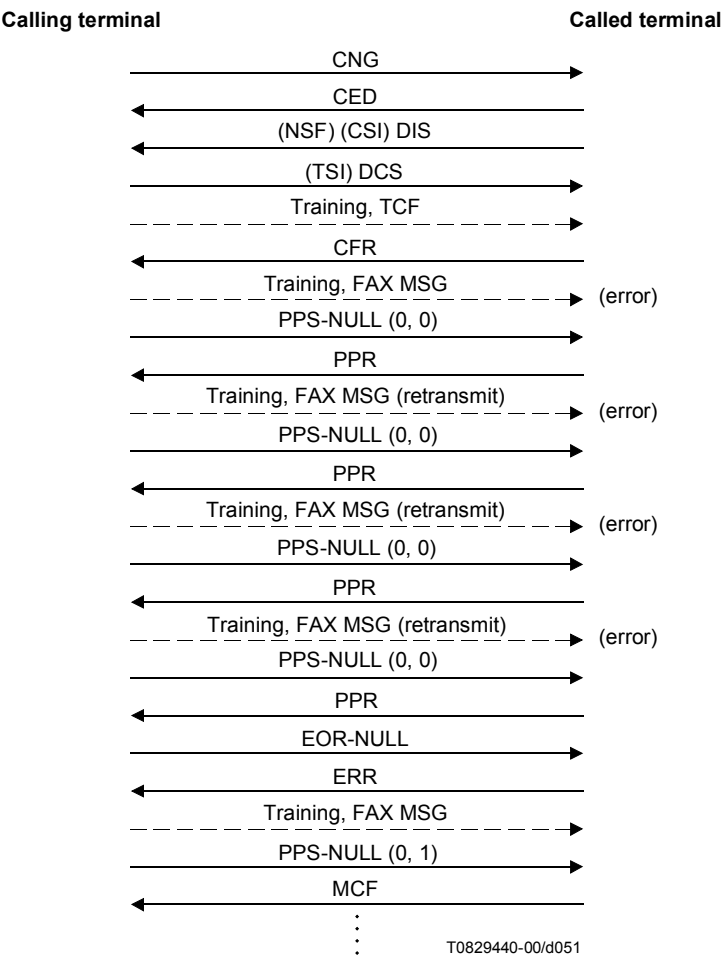


Figure A.7/T.30 (sheet 11 of 13)

Example 12 An auto calling terminal wishing to transmit to an auto answer terminal:
example of EOR (first page was not satisfactorily received).

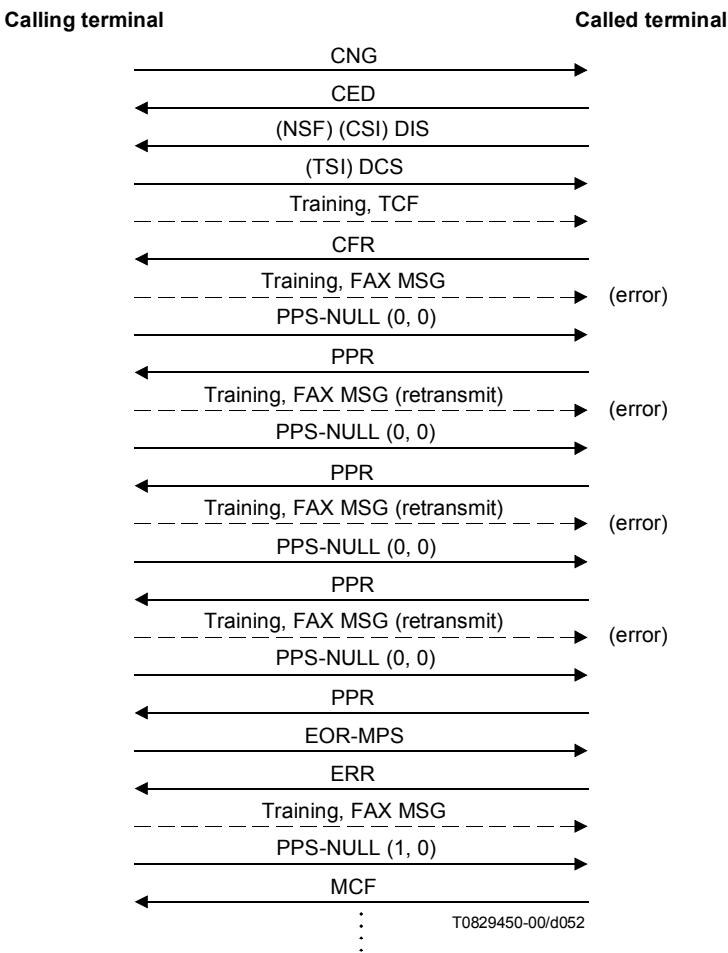


Figure A.7/T.30 (sheet 12 of 13)

Example 13 An auto calling terminal wishing to transmit to an auto answer terminal:
example of all frames and flag sequences in FAX MSG failure to receive.

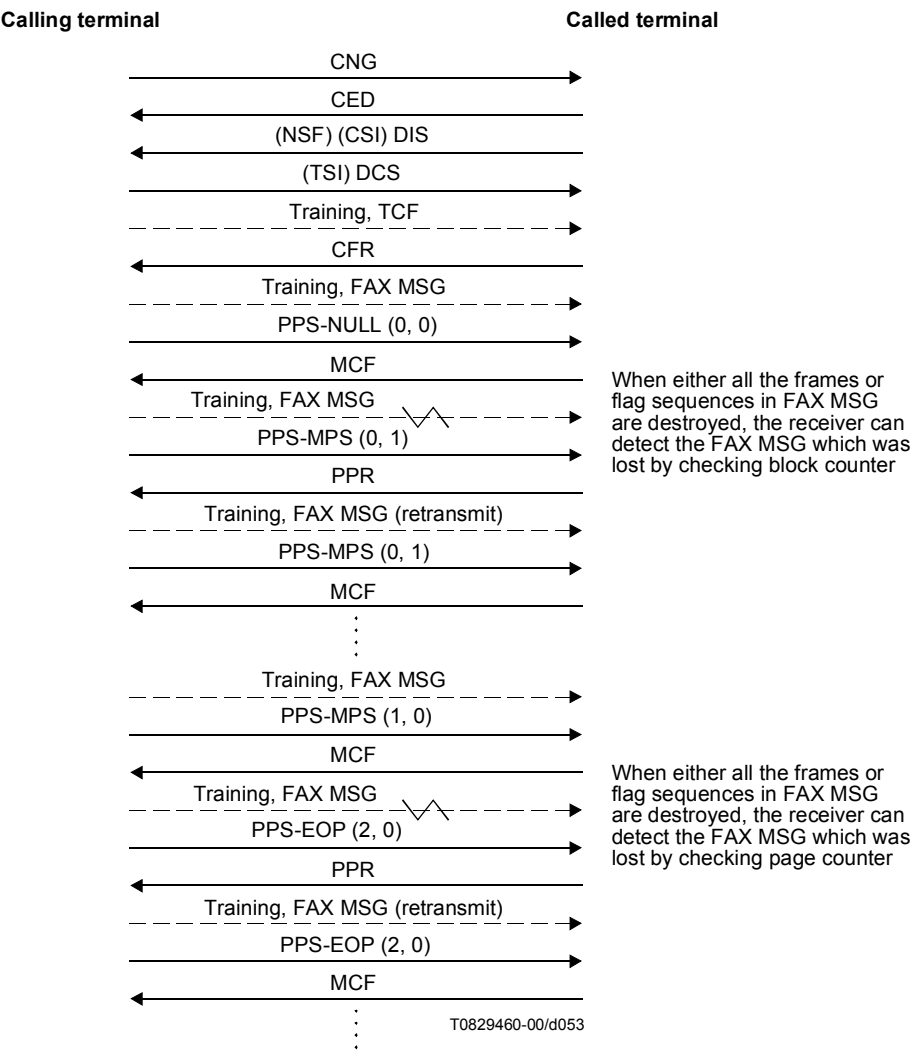


Figure A.7/T.30 (sheet 13 of 13)

Annex B

BFT diagnostic message

B.1 Introduction

This annex defines the signals and procedures which shall be used when conducting Binary File Transfer (BFT) or BFT negotiation operations within Group 3 facsimile. The syntax and use of the file diagnostic message (FDM) frame within Group 3 facsimile are defined. The methods which are described shall be applicable when using the Binary File Transfer format defined within ITU-T Rec. T.434. The purpose of BFT negotiations within Group 3 facsimile is to confirm that the attributes of a file transfer request will be acceptable to the receiver prior to the actual transfer of binary file data.

B.2 Normative references

- ITU-T Recommendation T.434 (1999), *Binary file transfer format for the telematic services*.
- ITU-T Recommendation X.680 (2002) | ISO/IEC 8824-1:2002, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation*.

B.3 Definitions

The *File Diagnostic Message (FDM) frame* is an optional post-message response which may be sent by the receiver. It provides the transmitter with diagnostic information concerning the current transfer taking place. The semantics and the syntax of the FDM are described in ITU-T Rec. T.434 and extended for use in Group 3 facsimile within this annex (see B.8.2.1).

B.4 Signals and components for BFT file transfer operations

B.4.1 Diagnostic messages in Group 3 facsimile

The file diagnostic message may be used during BFT file transfer operations or as part of BFT negotiations within Phase C of the facsimile procedure. The syntax and procedures for use of diagnostic messages within Group 3 facsimile file transfer procedures are defined below. The use of diagnostic messages during BFT negotiations in Phase C is defined in B.6.3.1.

B.4.2 Use of diagnostic messages during file transfer operations

The diagnostic information may be composed of one or more messages. Each message is informative, transient or permanent. An informative message does not require recovery and does not affect the current state of the BFT. A transient message may not re-occur if the sequence of events is repeated but does imply the failure of the present BFT being performed. A permanent message is sent every time the sequence of events is repeated, and implies the failure of at least the present BFT being performed.

A diagnostic message may be sent in place of an MCF frame. The message may be sent using one or more HDLC frames. If more than one HDLC frame is used, only the last one will have the control field set for a final frame. The encapsulation of the diagnostic information within a frame is completely independent of attribute boundaries. However, each frame must meet the transmission requirements of this Recommendation.

If the transmitter receives a transient or permanent message, it should review the set-up for the current binary file being transmitted. Control will continue as though four PPRs were received (emission of CTC command).

B.4.3 Syntax of FDM Facsimile Information field

The syntax for the FDM Facsimile Information field is defined in B.8.2.

B.5 Service models for BFT negotiations

There are two service models for Binary File Transfer negotiations within Group 3 facsimile. The two models are:

- 1) File Transfer Request;
- 2) Identification of Capabilities.

Depending upon the application, elements of one or both service models may be used in order to successfully complete a BFT negotiation. The two service models are defined below.

B.5.1 File Transfer Request

When this service model is used, the facsimile transmitter makes a File Transfer Request and the receiver responds with either a positive or negative acknowledgement. If the initial request is not accepted, the transmitter may choose to make additional requests.

B.5.2 Identification of Capabilities

In this service model, the called facsimile terminal identifies its file transfer capabilities, optionally including a list of support file types, and then the sender makes a selection from the list of supported capabilities.

B.6 Signals and components for BFT negotiations

It is possible to conduct Binary File Transfer negotiations via either a simple Phase C mode, using the traditional DIS/DTC/DCS negotiations or in an extended, Phase B, mode, using extended signals. The signals and settings which are used for the simple mode and the extended mode are defined below.

B.6.1 Settings for DIS/DTC bits

A receiver shall indicate support for the simple Phase C method by setting bit 99 within the DIS or DTC to "1". A transmitter may indicate the intention to proceed with a file request using the simple Phase C method by setting bit 99 within the DCS.

A receiver shall indicate support for the extended Phase B method, by setting bit 100 in the DIS or DTC to "1", and by using the extended settings as shown in the next clause.

B.6.2 Settings for extended signals

Extended signals protocol may optionally be used to conduct Binary File Transfer negotiations that support extended features. The extended features may include:

- 1) identification of BFT capabilities;
- 2) conducting single or multi-pass BFT negotiations via the file request method within Phase B of the Group 3 facsimile procedure.

The use of the extended signals to select further BFT negotiations method via the Phase C method is for further study.

The following signals are used for Phase B negotiations:

- FNV, RNR and RR as defined in the main body of this Recommendation (see 5.3);
- DES, DER, DTR, DEC, TNR, TR, DNK as defined in Annex H (see H.6.1).

Supergroups

The following Supergroup 8 bit code should be used to introduce the groups which are applicable for extended Binary File Transfer Negotiations: "0000 0100".

Groups

The groups which may be used for extended Binary File Transfer negotiations are shown below.

Table B.1/T.30 – Groups for Binary File Transfer negotiations

Group code	Name	Data content	Description
0000 0001	Negotiations	Bit settings defined in Table B.2	Define bit settings for Phase B
0000 0010	Transfer Request	See guidelines in B.7.1.	Transmitter presents tags for a file transfer request.
0000 0011	File Types	See guidelines in B.7.2.	Receiver presents a list of supported binary file types.
0000 0101	Media types	See guidelines in B.7.2.	Receiver presents a list of supported media methods
0000 0100	Compression Types	See guidelines in B.7.2.	Receiver presents a list of supported compression methods.
0000 0101	Capabilities Request	Bit settings as defined in Table B.3	Request to see if receiver supports specific lists of capabilities
NOTE – The unused bits of this value octet are set to "0" by default.			

Table B.2/T.30 – Coding of the value octet for the negotiations group

Meaning of codes	Coding of the value octet of the negotiations group
Reserved for Simple Phase C BFT Negotiations Capability/Command	Bit No. 7 6 5 4 3 2 1 0 1 x x x x x x x
Extended BFT Negotiations Capability/Command	Bit No. 7 6 5 4 3 2 1 0 x 1 x x x x x x
Bits 0 to 5 are reserved for future use	Bit No. 7 6 5 4 3 2 1 0 x x x x x x x x
NOTE – The unused bits of this value octet are set to "0" by default.	

Table B.3/T.30 – Coding of the value octet for the Capabilities Request group

Meaning of codes	Coding of the value octet of the negotiations group
Request List of Supported File Types	Bit No. 7 6 5 4 3 2 1 0 1 x x x x x x x
Request list of Supported Compression Types	Bit No. 7 6 5 4 3 2 1 0 x 1 x x x x x x
Request List of Supported Media Types	Bit No. 7 6 5 4 3 2 1 0 x x 1 x x x x x
Bits 0 to 4 are reserved for future use	Bit No. 7 6 5 4 3 2 1 0 x x x x x x x x

B.6.3 Use of Group 3 Fax Signals for BFT negotiations

B.6.3.1 Simple Phase C method

The Simple Phase C method for BFT negotiations may be selected using the traditional DIS/DTC negotiations method. A file transfer request using the Simple Phase C method is submitted by

presenting BFT negotiations data within Facsimile Coded Data frames available within Group 3 error correction mode. The MCF (message confirmation) signal is used to accept the file request and the File Diagnostic Message (FDM) is used to reject the file request. The syntax of the FIF of the FDM signal for Group 3 facsimile is defined in B.8.2.1.

B.6.3.2 Extended Method – Phase B

A facsimile receiver may identify its BFT negotiations capabilities, optionally including lists of supported file types and values for other BFT attributes, using the DES signal. Where applicable, for polling operations, a terminal may identify its BFT negotiations capabilities using the DTR signal.

The following extended signals may be used when conducting file transfer negotiations within Phase B: DES, DEC, DER, DTR.

The FNV signal shall be used for the purpose of a negative acknowledgement, when it is necessary to reject all or part of a BFT file request via Phase B. Per Annex H, when all extended negotiations are complete, the CFR signal is issued by the receiver.

The following signals may be used for flow control during Phase B, per the procedures defined within H.6.3: TNR, TR, RNR, RR. The FNV and DNK signals provide error control features as defined within H.6.

B.7 Procedures for BFT negotiations

B.7.1 File Transfer Request

B.7.1.1 Phase C method

A receiver shall indicate support for the Phase C method by setting bit 99 within the DIS or DTC to "1". A transmitter may indicate the intention to proceed with a file request using the Phase C method by setting bit 99 within the DCS.

B.7.1.2 Phase B method

A transmitting terminal may issue a file transfer request within Phase B by using either the DER or DEC signal, where the FIF shall include the BFT Negotiations supergroup and the Transfer Request group. The data content of the Transfer Request group shall consist of all or a subset of the T.434 tags for the proposed file transfer (see B.7.2.1). The DER signal shall be used where additional information is needed from the receiver before completing the negotiation. The DEC signal shall be used when issuing a command where further information is not requested from the receiver.

B.7.2 Identification of Capabilities

A called or receiving terminal may identify its BFT capabilities using the DES signal (or the DTR signal when polled operations are to be requested). The capabilities are contained within the Facsimile Information Field of the DES/DTR and are encoded using the BFT supergroup and one or more related groups. The terminal indicates support for BFT negotiations using the Negotiations group. The terminal may indicate support for specific capabilities using the following groups:

- 1) File Types – list of supported BFT file types.
- 2) Compression Types – list of supported BFT compression types.
- 3) Media Types – list of supported BFT media types.

NOTE – Identification of Capabilities is only available with the Phase B method.

B.7.3 BFT File Transfer Response**B.7.3.1 Simple Phase C method**

The receiver indicates acceptance of a file transfer request by issuing an MCF signal. The receiver may reject a file transfer request by issuing an FDM signal containing a T.434 diagnostic message code indicating the reason for the rejection. The receiver may optionally return the T.434 tags and values which are not accepted as part of the FDM diagnostic information.

B.7.3.2 Enhanced Phase B method

The receiver indicates acceptance of a file transfer request by issuing a DES signal in response to a request made via the DER signal or a CFR in response to the DEC command. The receiver may reject a file transfer request by issuing an FNV signal with the BFT negotiations reason code set and is required to return a T.434 diagnostic message code indicating the reason for the rejection. The receiver may optionally return the T.434 tags and values which are not accepted as part of the FNV diagnostic information.

B.8 Presentation of BFT negotiations data

This clause offers rules on how BFT data should be presented during BFT negotiations and syntax for the related signals.

B.8.1 BFT File Transfer Request

For a binary file transfer request, the full ASN.1 coding for a BINARY-DATA-Message shall be used as defined in ITU-T Rec. T.434. All or a subset of the tags may be presented during the request. The data-contents tag, length and value may be omitted. Only definite length coding shall be used.

B.8.1.1 Phase C method File Transfer Request

Syntax for Phase C method Transfer Request:

Phase C Signal ::= <T.434 Binary Data Message>

B.8.1.2 Phase B method File Transfer Request

Syntax for Phase B method Transfer Request:

Phase B method signal: DER or DEC.

Group Structure:

Tag Encoded Data ::=

<BFT Negotiations SG><SG Length>< Transfer Request Group Tag><Group Length><Group Value>

<Group Value> ::= <T.434 Binary Data Message>

B.8.2 BFT File Transfer Response

For a response to a BFT File Transfer request, the following presentation rules apply:

- 1) Only definite length coding is permitted.
- 2) If multiple tags are to be returned, use the "IMPLICIT SEQUENCE OF SEQUENCE" coding.
- 3) If only a single tag is to be returned, only present the ASN.1 syntax for that tag (and data as applicable).

B.8.2.1 Phase C method File Transfer Response

Phase C method signals: FDM, MCF.

Syntax for FDM Response

FIF ::= <Diagnostic Code>[<Frame Number><Diagnostic Information>]

where the <Diagnostic Information> ::= <Length><Rejected T.434 data>

The structure of the octets of the FIF for the FDM frame shall be as follows:

Octet	Contents	Requirements	Additional comments
First	Diagnostic code	Mandatory	Values defined in Table B.3/T.434
Second	Frame number	Optional	To allow multi-frame responses.
Additional octets	Diagnostic information	Optional	Structure for rejected T.434 data

The format of the rejected T.434 data shall follow the rules defined in B.8.2.

B.8.2.2 Phase B Method File Transfer Response

Phase B method signals: FNV, DES, CFR.

Syntax for FNV Response.

FNV bit setting for BFT Negotiations Rejection: bit n

FIF ::= <first octet><extend octet><frame_number><FDM_diagnostic_code><length>
<rejected_T434_data>

The rejected T.434 data are coded based on the presentation rules for responses. The values for the FDM_diagnostic_code are contained in Table B.3/T.434.

B.8.3 Lists of Capabilities

For lists of capabilities of a single attribute, called terminals or receivers use the ASN.1 "OF" syntax, followed by the list of tags and values. The following rules apply:

- Only definite length coding is permitted.
- Fax transmitters may make a specific request for lists of capabilities using the "Capabilities Request" group, whose structure and syntax is defined in B.8.4.

B.8.3.1 Syntax for File Types Capability List

Phase B method signal: DES or DTR.

Group Structure:

Tag Encoded Data ::=

<BFT Negotiations SG><SG Length><File Types Group Tag><Group Length><Group Value>

<Group Value> ::= <SEQUENCE OF OBJECT IDENTIFIER >

B.8.3.2 Syntax for Compression Types Capability List

Phase B method signal: DES or DTR.

Group Structure:

Tag Encoded Data ::=

<BFT Negotiations SG><SG Length><Compression Types Group Tag><Group Length><Group Value>

<Group Value> ::= <SEQUENCE OF OBJECT IDENTIFIER >

B.8.3.3 Syntax for Media Types Capability List

B method signal: DES or DTR.

Group Structure:

Tag Encoded Data ::=

<BFT Negotiations SG><SG Length><Media Types Group Tag><Group Length><Group Value>

<Group Value> ::= <SEQUENCE OF Mime-Media-Type-Attribute >

NOTE – The syntax of the Mime-Media-Type-Attribute is defined in ITU-T Rec. T.434.

B.8.4 Capabilities Request

Transmitters may make a specific request for lists of capabilities using the "Capabilities Request" group. One or more requests may be made at a time, depending upon the bit settings for the group value octet.

B.8.4.1 Syntax for Capabilities Request

B Method signal: DER.

Group Structure:

Tag Encoded Data ::=

<BFT Negotiations SG><SG Length><Capabilities Request Group Tag><Group Length><Group Value>

The group value is a single octet as defined in Table B.3.

Annex C

Procedure for Group 3 document facsimile transmission on the Integrated Services Digital Network or on the GSTN using duplex modulation systems

C.1 Introduction

C.1.1 This annex describes the protocol used by Group 3 document facsimile terminals when operating over the Integrated Services Digital Network. Optionally, the protocols described in this annex may be used on digital networks other than the ISDN. The protocols described in this annex may also be used on the GSTN using modulation schemes. The procedures and signals used are based upon those defined in the main body as well as in Annex A. The protocol operates in either half-duplex only or duplex and half-duplex mode. In both cases, error correction is an integral part of the protocol. The Group 3 facsimile option described in this annex may be referred to as Group 3 Option C or Group 3C.

C.1.2 Outline of the error correction method

The error correction method described in this Recommendation is based on page selective repeat ARQ (Automatic Repeat Request) technique. An HDLC frame structure is utilized for all facsimile message procedures.

The transmitting terminal divides the message into a number of concatenated frames as described in Annex A/T.4 and transmits it as a number of pages and/or partial pages.

The transmitting terminal uses a frame size of 256 octets as indicated in the DCS command and the receiving terminal must be able to receive a frame of that size. Optionally, when operating over analogue networks, a frame size of 64 octets may be indicated by the transmitting terminal.

In the duplex mode of operation, the transmitting terminal transmits subsequent partial pages without waiting for a response to the preceding partial page. If corrections are required, they are sent at the end of the next partial page transmission. If there are any unacknowledged commands from previous pages or partial pages, these are retransmitted prior to any corrections. In the half-duplex case, all corrections are sent and acknowledged before a subsequent partial page is sent.

When the previous message has not been satisfactorily received, the receiving terminal transmits a PPR response to indicate that the frames specified in the associated facsimile information field are required to be retransmitted. The PPR signal contains the page and block numbers as well as the required frame numbers.

When a PPR signal is received, the transmitting terminal retransmits the requested frames specified in the PPR information field.

There is no predefined number of attempts to correct a page, the decision is left up to the transmitter. If it is considered that too many attempts have been made, then the transmitter will send the DCN signal.

If the receiver is unable to continue to receive new information, it sends RNR continuously until it is ready to receive new information. During this time the transmitter will send any outstanding correction frames and any unacknowledged commands. If there are no outstanding corrections, then it will continuously transmit any unacknowledged commands until it receives a response other than RNR.

The transmitter will send no new information until all previously transmitted pages are acknowledged as having been received correctly.

The format of the initial identification is a repeated sequence of XID + DIS or XID + NSF + DIS or XID + NSF + CSI + DIS sent three times concatenated together followed by 256 flags. This sequence is transmitted until a valid response is received from the calling terminal subject to a maximum time of 5 seconds.

The flow diagrams in C.5 do not address the issue of resilience against the remainder of the sequence but rather consider that this is implicitly ensured.

C.2 Definitions

C.2.1 When operating in the Group 3C mode, only the signals listed below are used. When used over the ISDN, the procedures and signals specified in this annex are carried on the B-channel. Unless stated otherwise, the signal functions and formats are as defined in the main body and/or in Annex A.

CIG	Calling Subscriber Identification (see Note)
CRP	Command Repeat
CSI	Called Subscriber Identification (see Note)
DCN	Disconnect
DCS	Digital Command Signal
DIS	Digital Identification Signal
DTC	Digital Transmit Command
FCD	Facsimile Coded Data
FCF	Facsimile Control Field

FIF	Facsimile Information Field
MCF	Message Confirmation (see C.3)
NSC	Non-Standard Facilities Command (see Note)
NSF	Non-Standard Facilities (see Note)
NSS	Non-Standard Set-up (see Note)
PID	Procedure Interrupt Disconnect (see C.3)
PPR	Partial Page Request
PPS-EOM	Partial Page Signal-End Of Message
PPS-EOP	Partial Page Signal-End Of Procedure
PPS-MPS	Partial Page Signal-Multipage Signal
PPS-NULL	Partial Page Signal-Null
RCP	Return to Control for Partial Page
RNR	Receiver Not Ready
TSI	Transmitting Subscriber Identification (see Note)
XID	EXchange IDentification procedure (see C.3)
NOTE – This signal is optional.	

C.3 Facsimile procedure

C.3.1 Call establishment procedures

The call establishment procedures for this option are defined in Annex F/T.90.

C.3.2 Initial identification

Exchange identification procedure (XID) – This signal indicates that the called terminal has Group 3C capabilities and also can be used to facilitate identification of the characteristics of the remote terminal when interworking with other facsimile groups. This signal is defined in ITU-T Rec. T.90.

The format of the XID frame is defined in Annex F/T.90.

C.3.3 In-message procedure

From the transmitter to the receiver. The in-message procedure formats and specific signals shall be as defined in Annex A/T.4.

C.3.4 Post-message responses

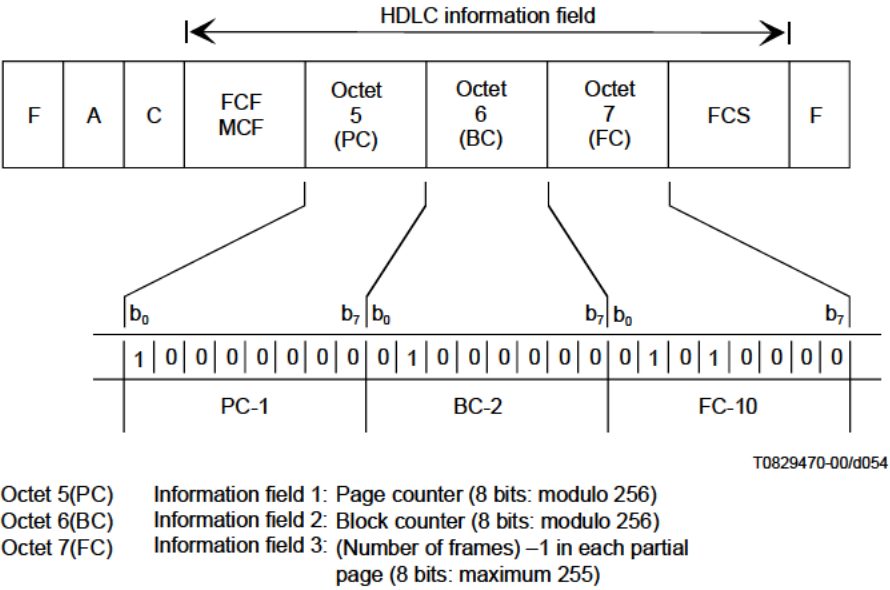
From the receiver to the transmitter.

Format: X011 XXXX

- 1) *Message Confirmation (MCF)* – This digital response indicates that a complete message has been satisfactorily received and that additional messages may follow. This is a positive response to PPS-MPS, PPS-EOM, PPS-EOP and PPS-NULL.

Format: X011 0001

The frame construction of MCF command and transmission order of bits included in octets 5-7 are shown in Figure C.1.



NOTE 1 – Octet 5: The page counter shows the page sequence modulo number for each call establishment in one direction of message transfer. The page counter is started from "0" and goes up to "255"; it is reset at the start of each call establishment.

NOTE 2 – Octet 6: The block counter shows the block sequence modulo number for each page. The block counter is started from "0" and goes up to "255"; it is reset at the start of each page.

NOTE 3 – Octet 7: The frame counter shows the total number of transmitted frames minus 1 in each partial page (maximum 255).

NOTE 4 – The least significant bit in octets 5-7 is transmitted first.

Figure C.1/T.30

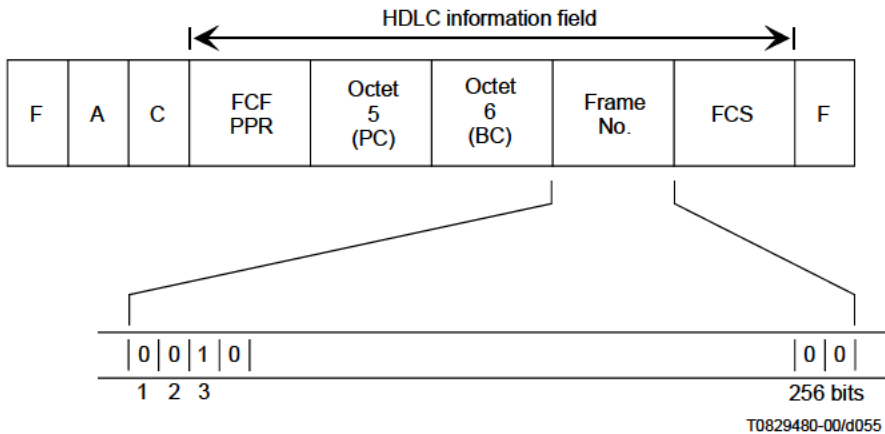
- 2) *Procedure Interrupt Disconnect (PID)* – This digital response indicates that a message has been received but that further transmissions are not possible and that after correction of all outstanding pages or partial pages, the transmitter shall enter Phase E. If a transmitter receives PID whilst it is transmitting a partial page, it shall stop sending that partial page immediately and send only the outstanding corrections (if any) to previous partial pages. The interrupted page shall be assumed as having been discarded at the receiver.
- In the half-duplex case, PID is sent at the end of a partial page and precedes any post-message response, i.e., MCF or PPR. The transmitter will continue to transmit the post-message command until it receives a valid response.
- Format: X011 0110
- 3) *Partial Page Request (PPR)* – This digital response indicates that the previous message has not been satisfactorily received and that the frames specified in the associated facsimile information field are required to be retransmitted.
- Format: X011 1101

The facsimile information field of the PPR signal is a fixed length of 272 bits. The first 8 bits define the page number and the second 8 bits define the block number. Each of the remaining 256 bits corresponds to an FCD frame within the relevant page and block, i.e.: the first bit to the first frame, etc. For FCD frames which are received correctly, the corresponding bit in the PPR information

field will be set to "0"; those that are received incorrectly or not received will have their bit set to "1".

If more than one PPR signal is transmitted, the bit corresponding to an FCD frame which has been received correctly must always be set to "0".

The frame construction of PPR response is shown in Figure C.2.



Octet 5(PC) Page counter (8 bits: modulo 256)
Octet 6(BC) Block counter (8 bits: modulo 256)

NOTE 1 – Octet 5: The page counter shows the page sequence modulo number for each call establishment in one direction of message transfer. The page counter is started from "0" and goes up to "255"; it is reset at the start of each call establishment.

NOTE 2 – Octet 6: The block counter shows the block sequence modulo number for each page. The block counter is started from "0" and goes up to "255"; it is reset at the start of each page.

NOTE 3 – The frame counter shows the total number of transmitted frames minus 1 in each partial page (maximum 255).

Figure C.2/T.30

- 4) *Receive Not Ready (RNR)* – This digital response is used to indicate that the receiver is not ready to receive more data. If a transmitter receives RNR, it shall stop sending new information at the end of the current partial page and transmit any requested corrections and/or any unacknowledged commands. Any unacknowledged commands shall be continuously transmitted until a response other than RNR is received. It shall not send any new information until all previously transmitted pages or partial pages have been acknowledged as being correctly received. If a transmitter receives RNR continuously for a period of 10 ± 1 s, it may transmit DCN and enter Phase E.

Format: X011 0111

C.3.5 Other line control signals

For the purpose of handling errors and controlling the state of the line.

Format: X101 XXXX

- 1) *Command Repeat (CRP)* – This response indicates that the previous pre-message command(s) was/were received in error and should be repeated (including any optional frames). Upon receiving CRP, a transmitter shall repeat all commands which have not yet been acknowledged. The CRP signal is sent continuously until an error-free command(s) is/are received.

Format: X101 1000

C.3.6 Facsimile information field (FIF)

C.3.6.1 DIS standard capabilities

The bit assignment for this information is given in Table 2 where a "1" indicates the condition is valid.

C.3.6.2 DCS standard commands

The DCS standard commands are formatted as shown in Table 2.

C.3.6.3 DTC standard command

The DTC standard capabilities are formatted as shown in Table 2.

C.3.7 Implementation requirements

C.3.7.1 Commands and responses

Whereas C.5 defines a flow diagram to give an accurate example of the typical use of the binary coded procedures, these procedures are defined specifically in terms of the actions that occur on receipt of commands by the receiving terminal.

A response must be sent, and only sent, upon detecting a valid command. Upon receiving a valid response, a new command must be issued within 3 seconds.

C.3.7.2 Timing considerations

C.3.7.2.1 Time-outs

Time-out T6 defines the amount of time two terminals will continue to attempt to identify each other. T6 is 5 ± 0.5 s. The time-out begins upon entering Phase B and is reset upon detecting a valid signal or when T6 times out.

Time-out T7 is used to detect loss of command/response synchronization. T7 is 6 ± 1 s. The time-out begins when initiating a command search (e.g., the first entrance into the "command received" subroutine – see flow diagram in C.5) and is reset upon detecting a valid signal or when T7 times out.

Time-out T8 defines the amount of time waiting for clearance of the busy condition of the receiving terminal. T8 is 10 ± 1 s, begins on the first detection of the combination of no outstanding corrections and the RNR response. T8 is reset when T8 times out or MCF response is received. If the timer T8 has expired, DCN command is transmitted for call release.

C.4 Flow control procedure

C.4.1 Flow control in the transmitting terminal is made by continuous flag transmission between frames or before the first frame.

C.4.2 The maximum transmission time of flags should be less than the value of timer T6.

C.4.3 In the case of transmission on noisy channel, a long flag sequence may be destroyed by noise. Therefore, it is recommended that the receiver implements a control procedure to discard invalid frames which are obtained from erroneous flag sequences.

C.4.4 Flow control in the receiving terminal is made using the RNR signal. An example is shown in Figure C.3.

C.5 Flow diagrams

The flow diagrams of Figures C.4 to C.23 show the Phase B pre-message procedures, Phase C message procedure, Phase D post-message procedures and Phase E call release for both the transmitting and receiving terminals.

For the notes and an explanation of terms to the flow diagrams, see 5.2.1 and C.5.1.

C.5.1 Explanation of flow chart terms

Unless defined otherwise below, the definition of the flow chart terms is given in the main body and/or in Annex A.

COPY QUALITY OK	All message frames have been received correctly or have been corrected.
OUTSTANDING COMMANDS	There are still some commands to which a response has not yet been received.
OUTSTANDING CORR?	There are still some pages or partial pages to which a positive acknowledgement has not yet been received.
RE-ISSUE COMMANDS	The "outstanding commands" are transmitted in their chronological order prior to transmission of the next page or partial page.

NOTE 1 – At any time during the operation, an interrupt may be generated which would result in a procedural interrupt. It is understood that if this interrupt happens during the transmission of the document, all the outstanding partial pages will be corrected if necessary prior to invoking the procedural interrupt.

NOTE 2 – CRP is used only in the case of a pre-message command being received in error.

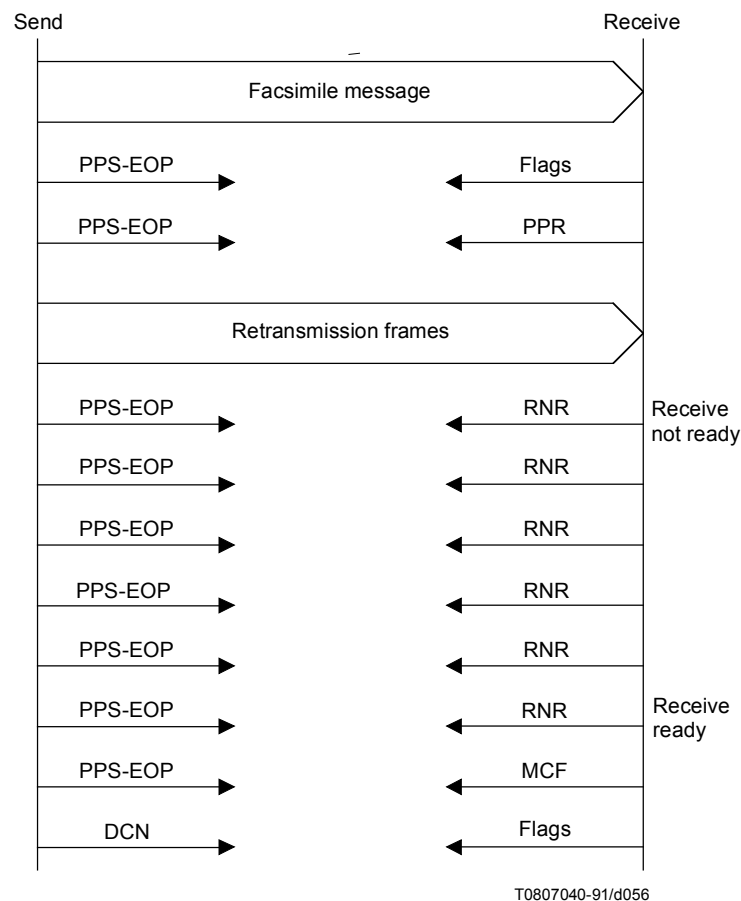


Figure C.3/T.30

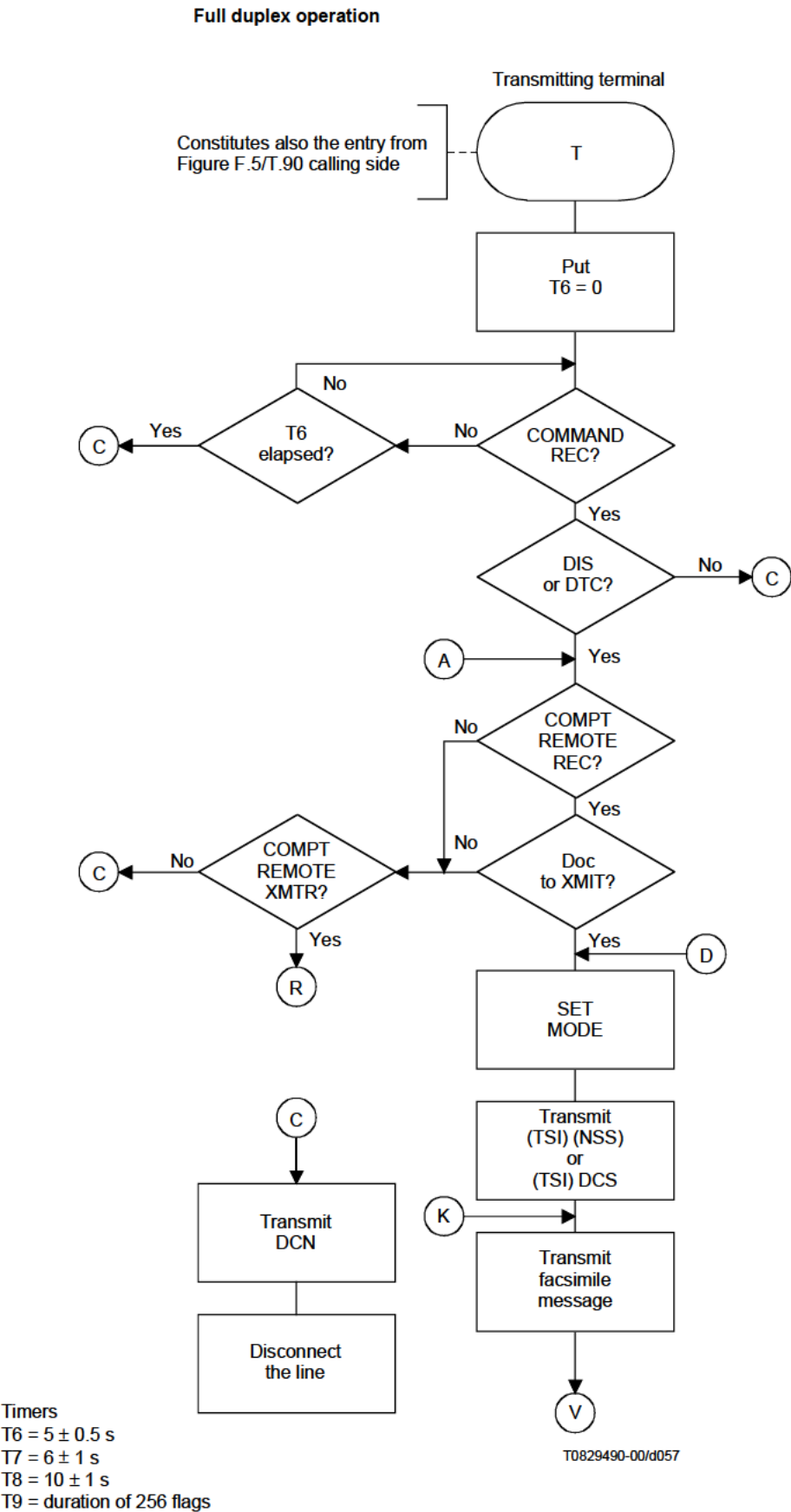


Figure C.4/T.30

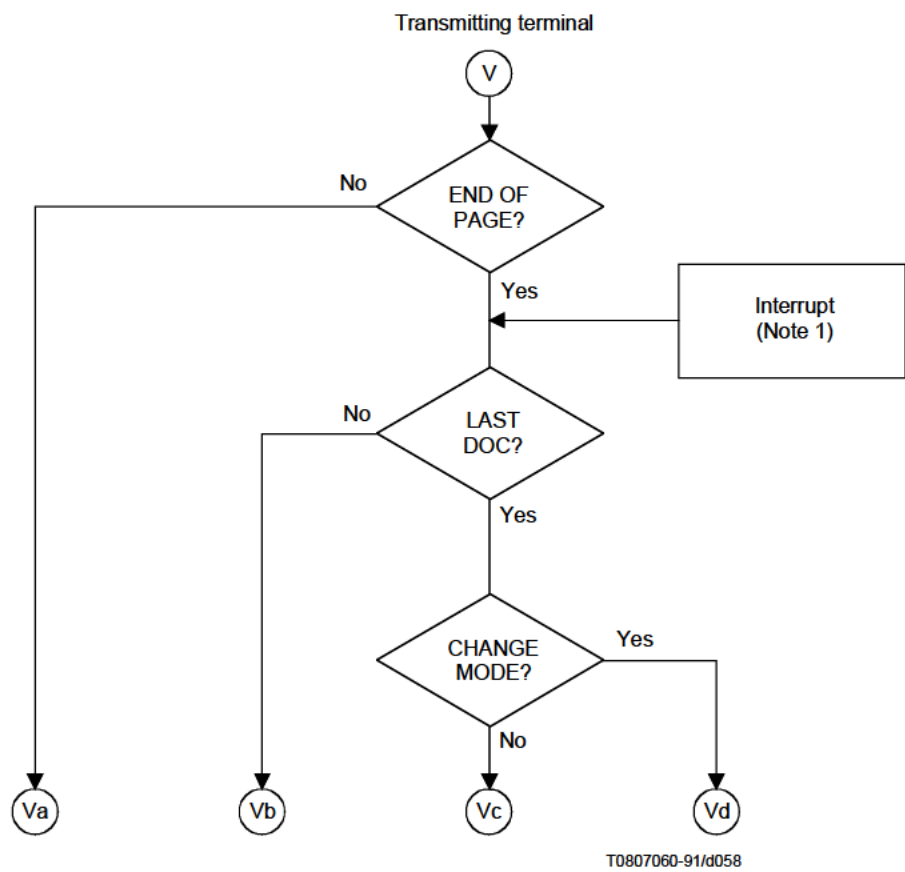
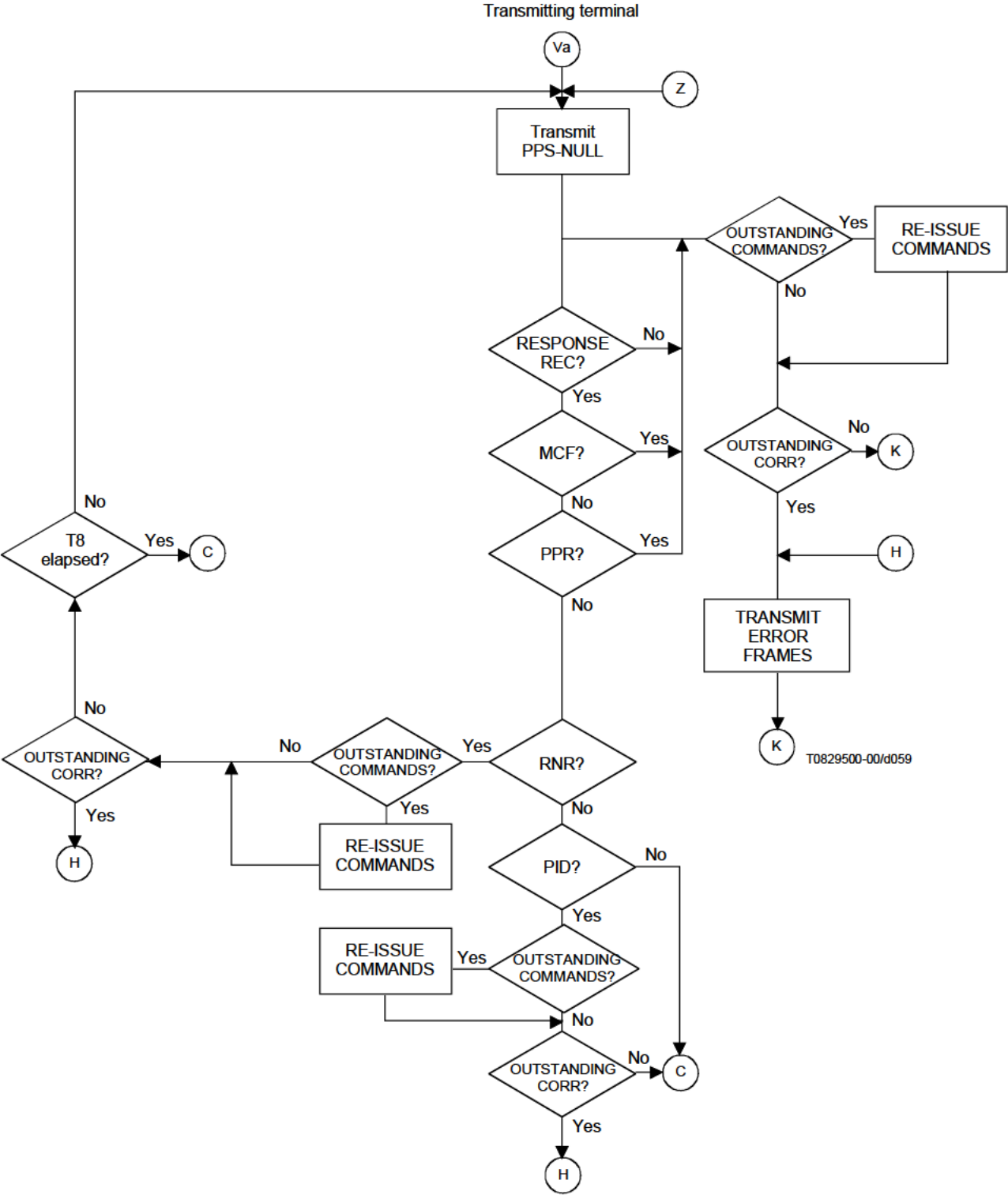


Figure C.5/T.30



T0829500-00/d059

Figure C.6/T.30

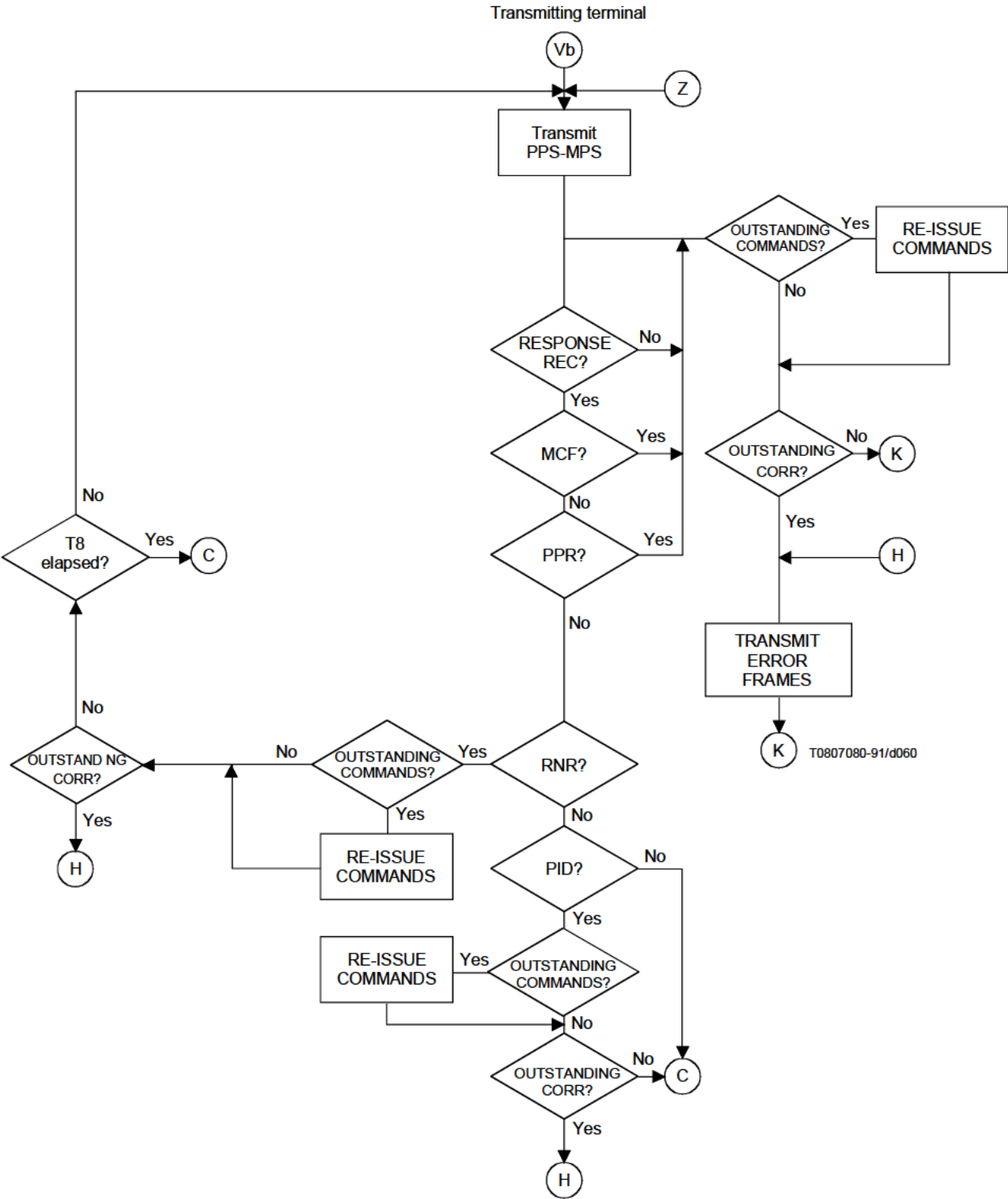


Figure C.7/T.30

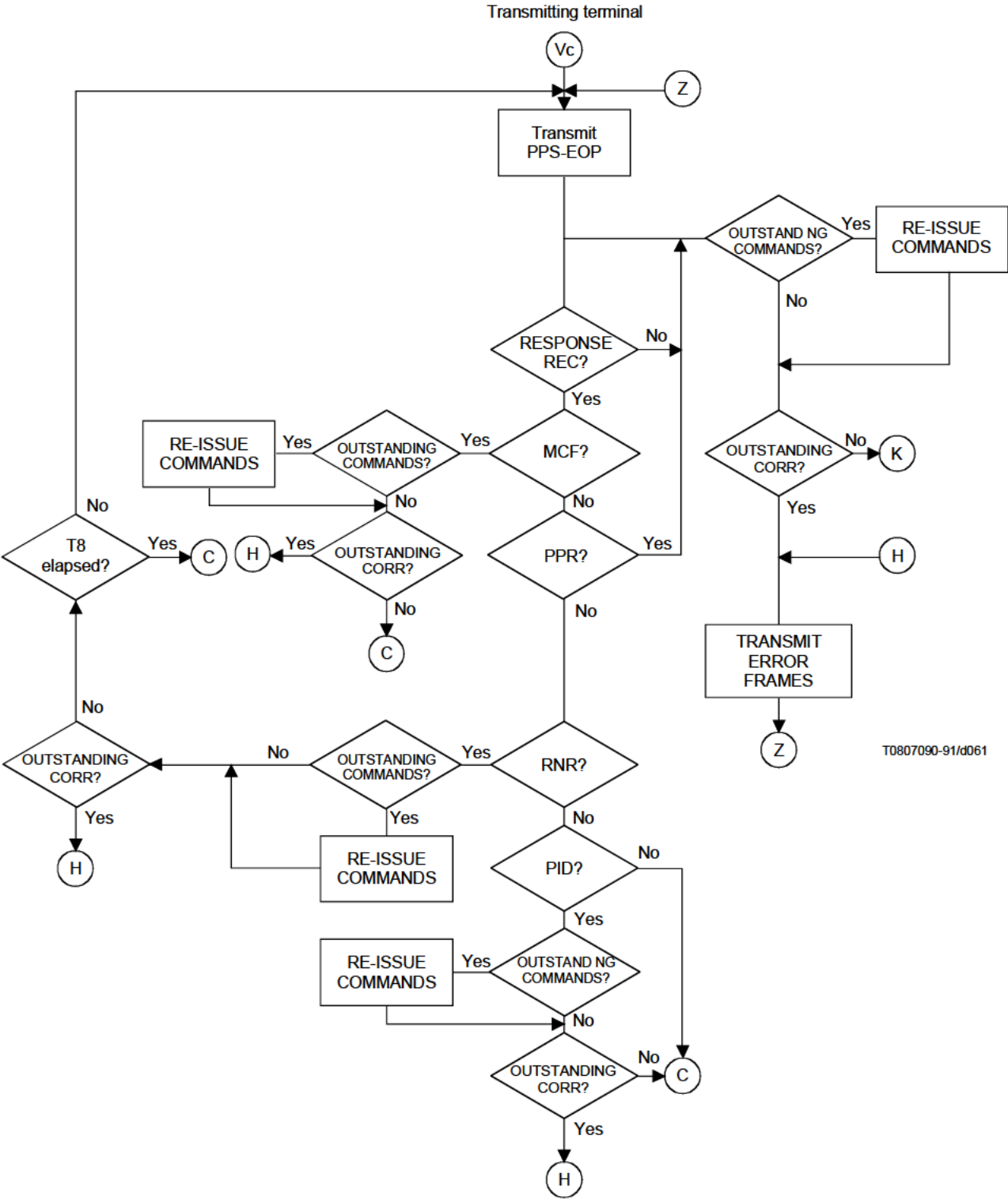


Figure C.8/T.30

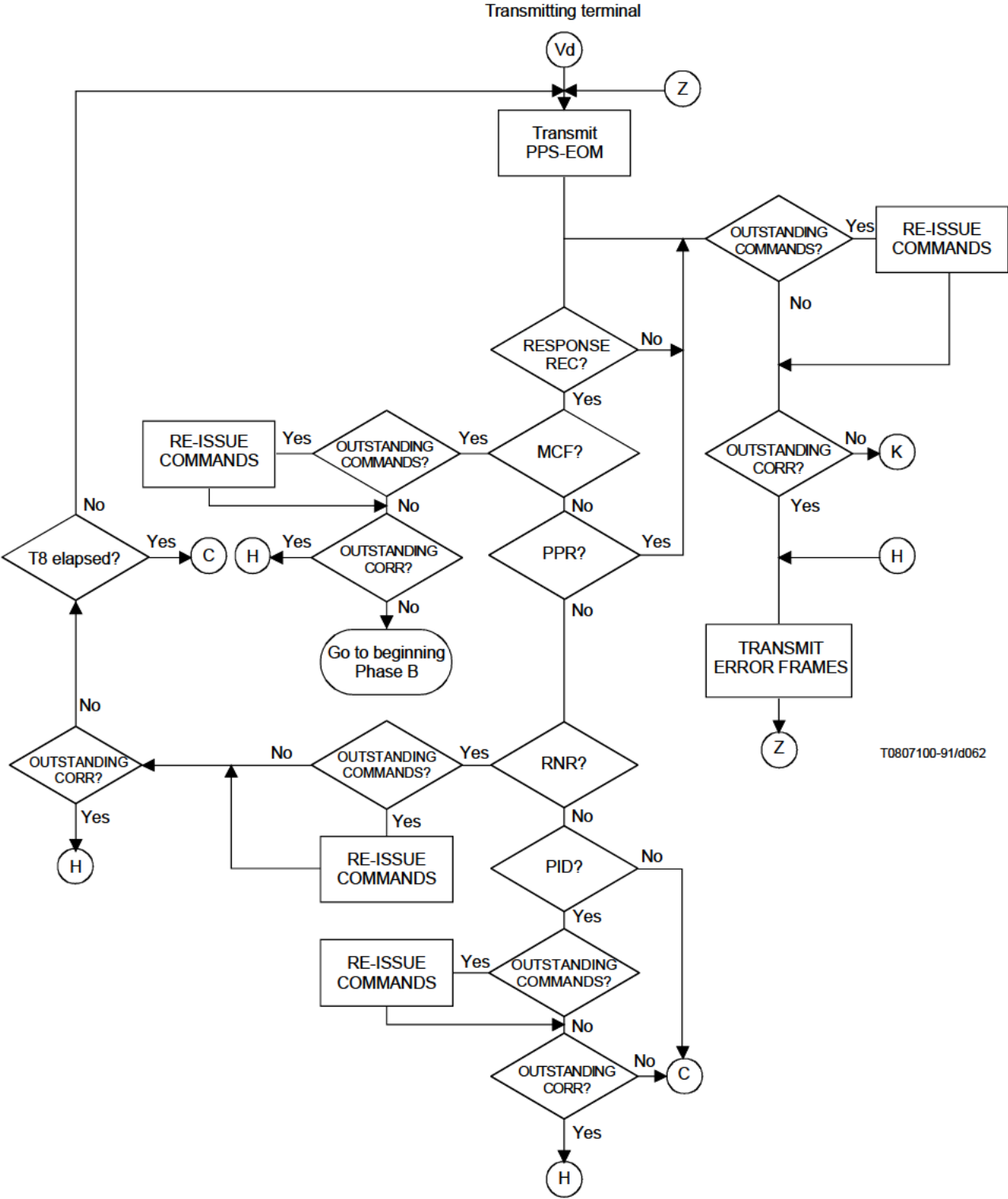


Figure C.9/T.30

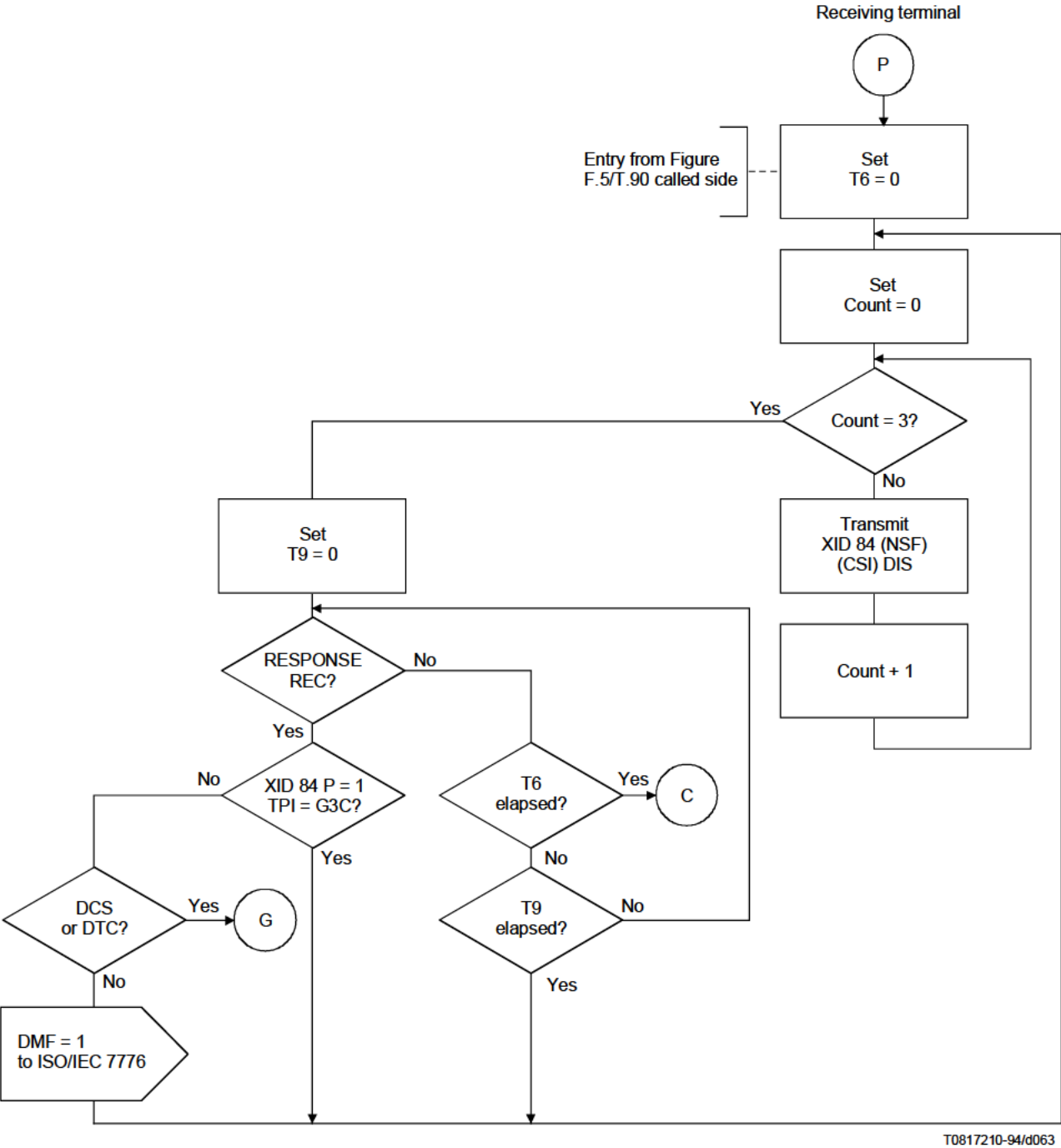


Figure C.10/T.30

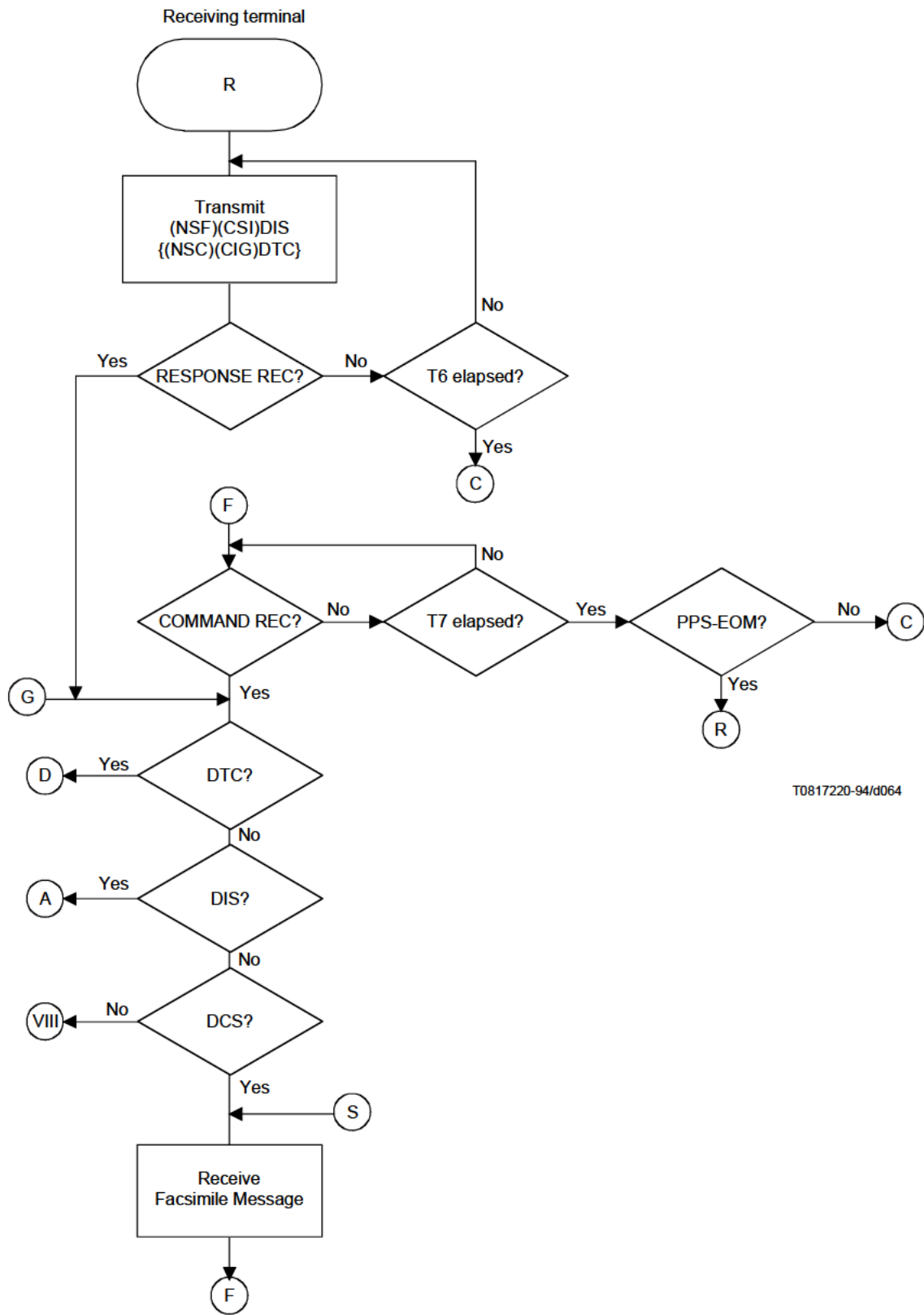


Figure C.11/T.30

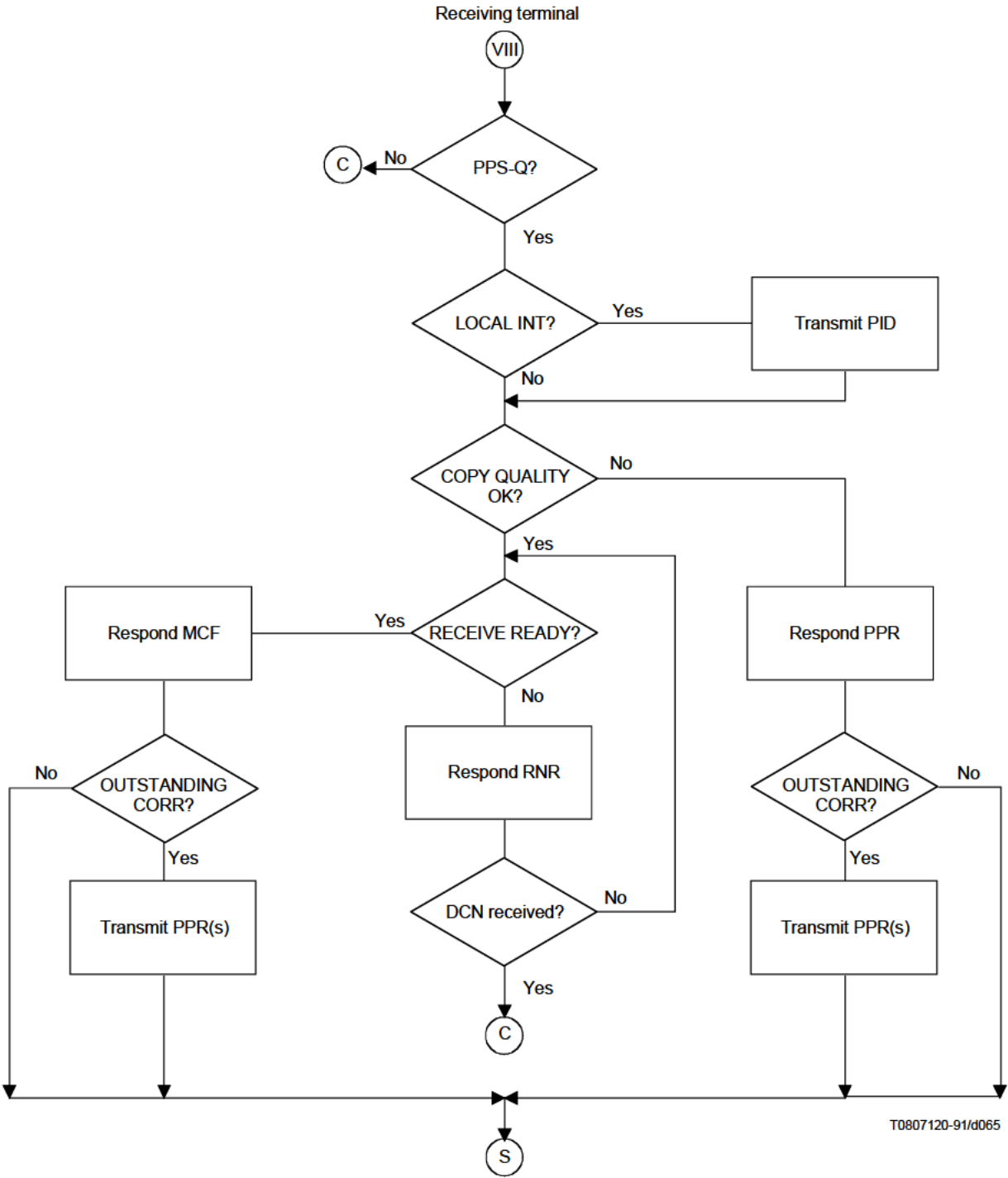


Figure C.12/T.30

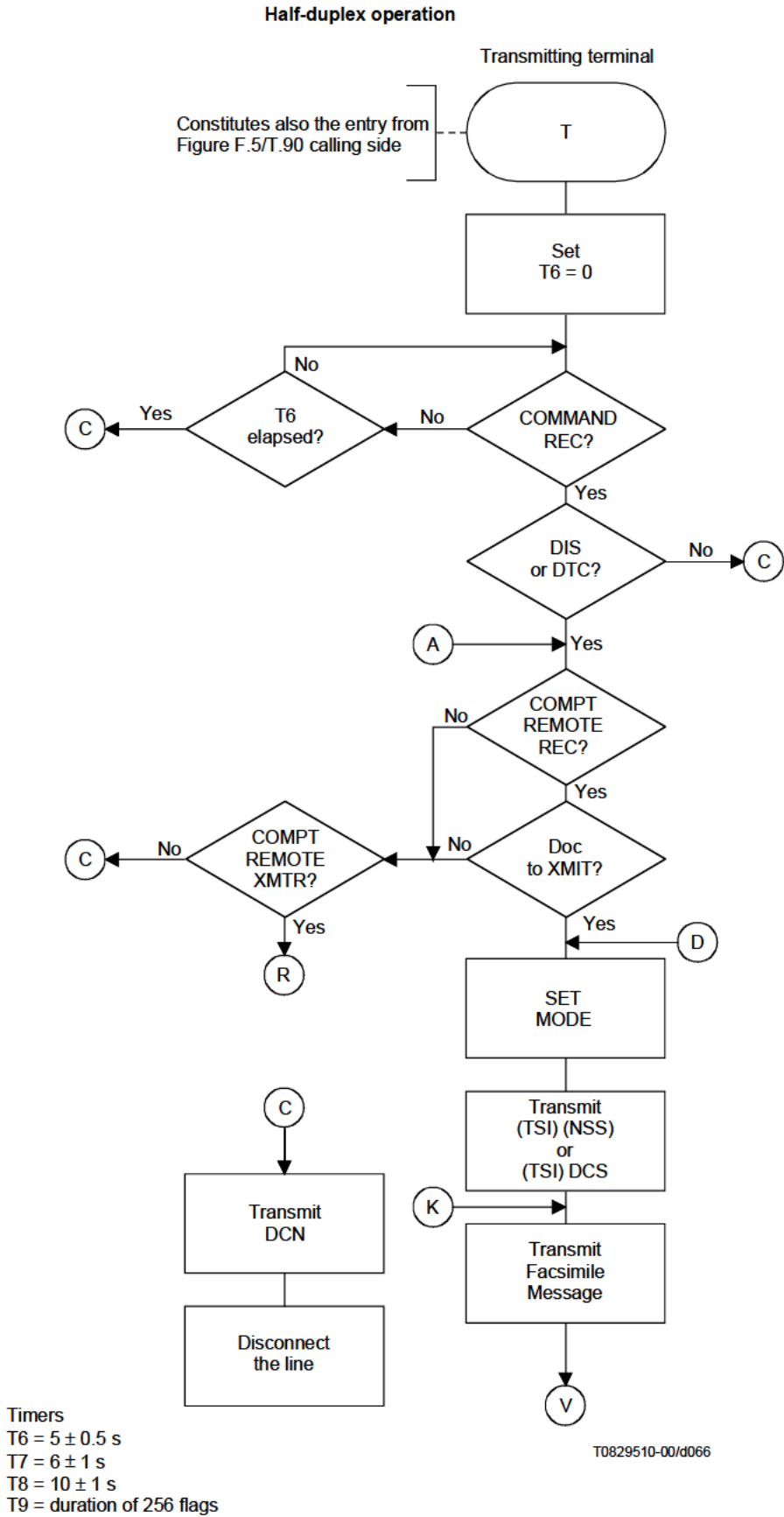


Figure C.13/T.30

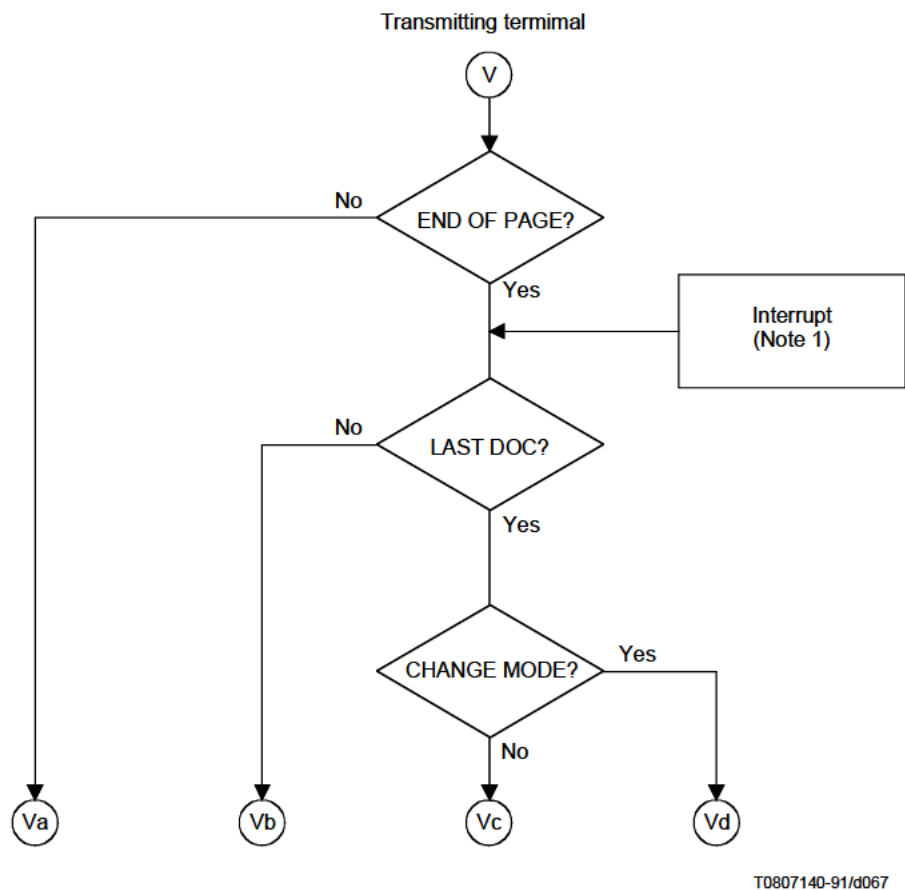


Figure C.14/T.30

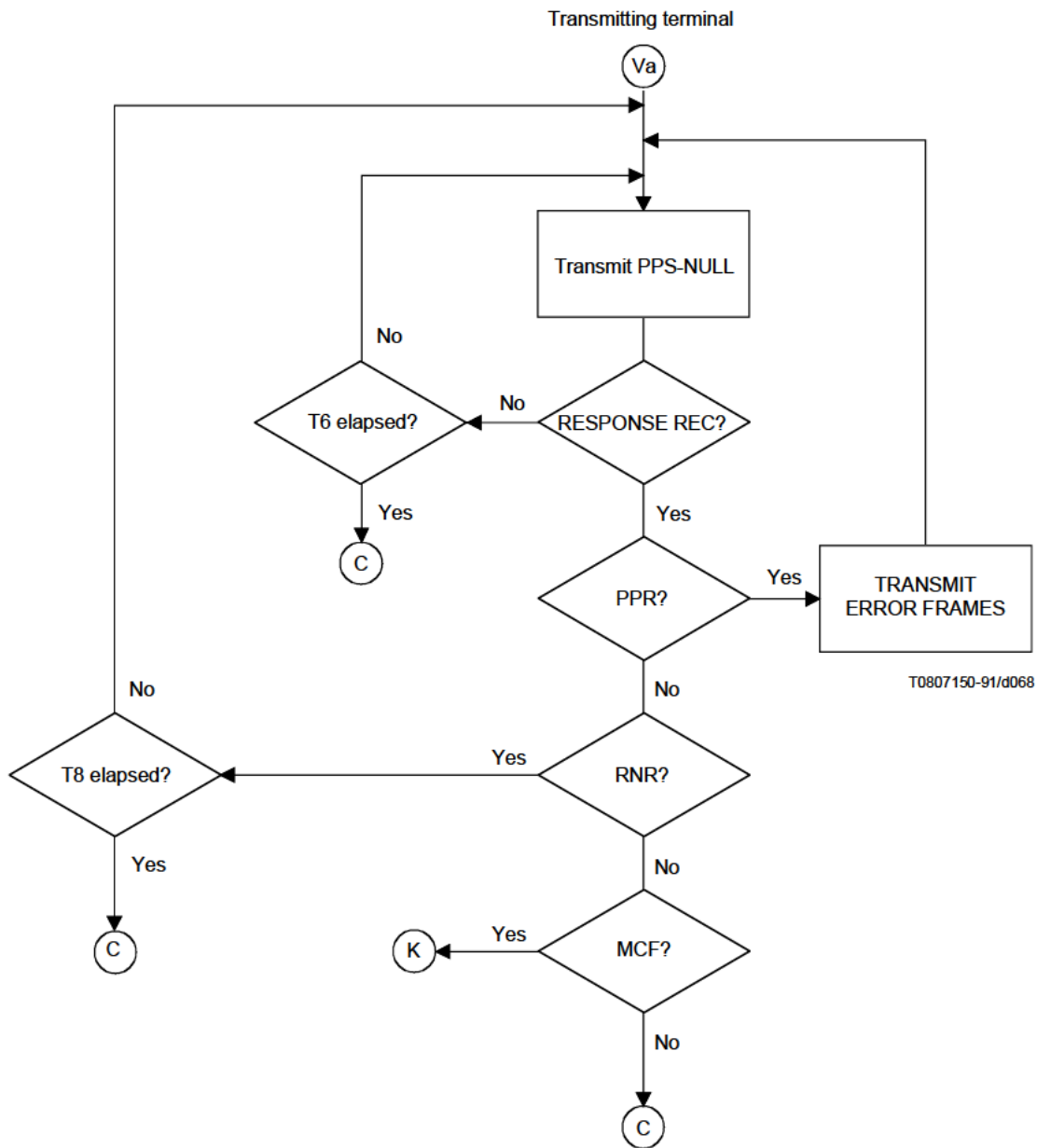


Figure C.15/T.30

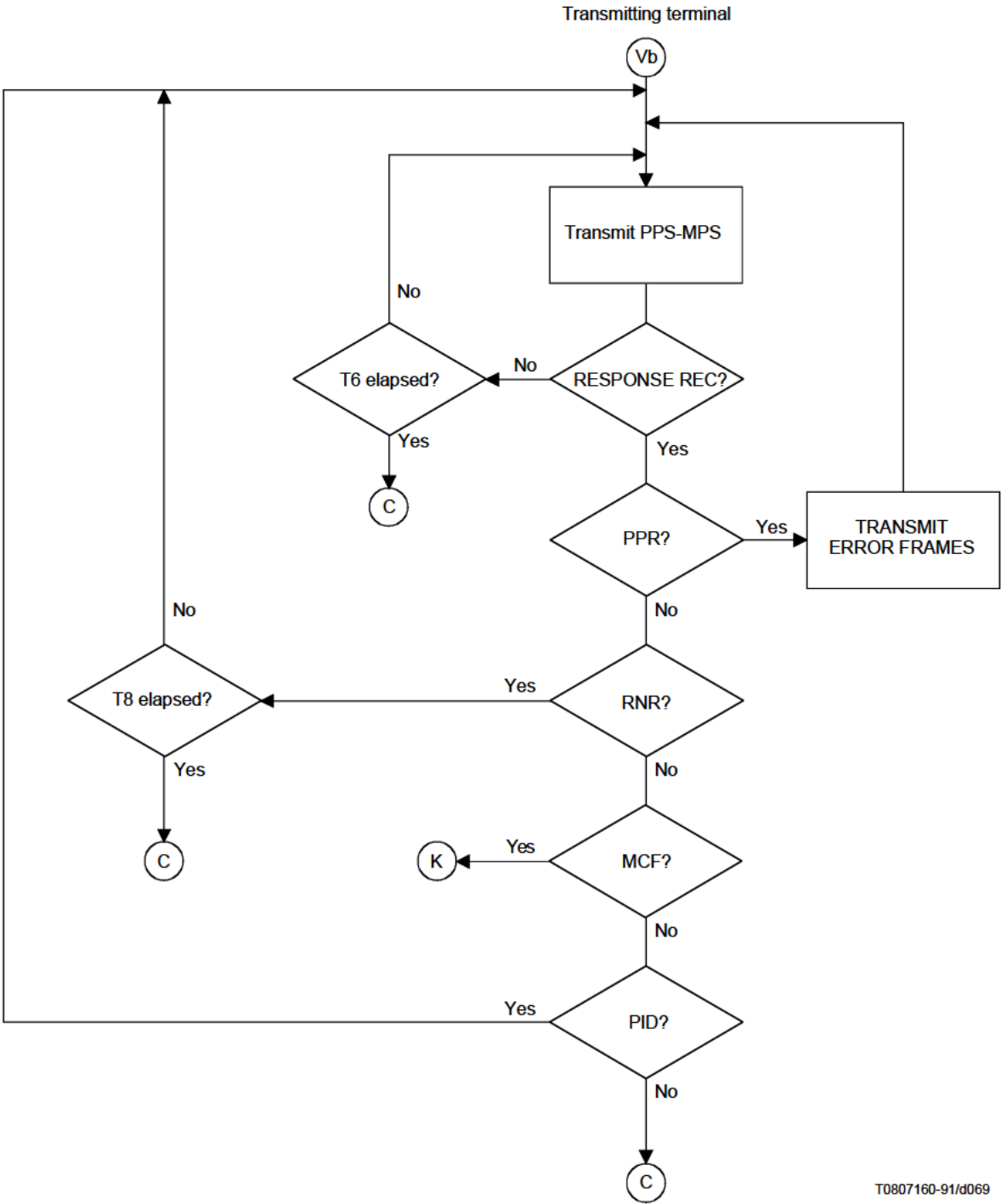


Figure C.16/T.30

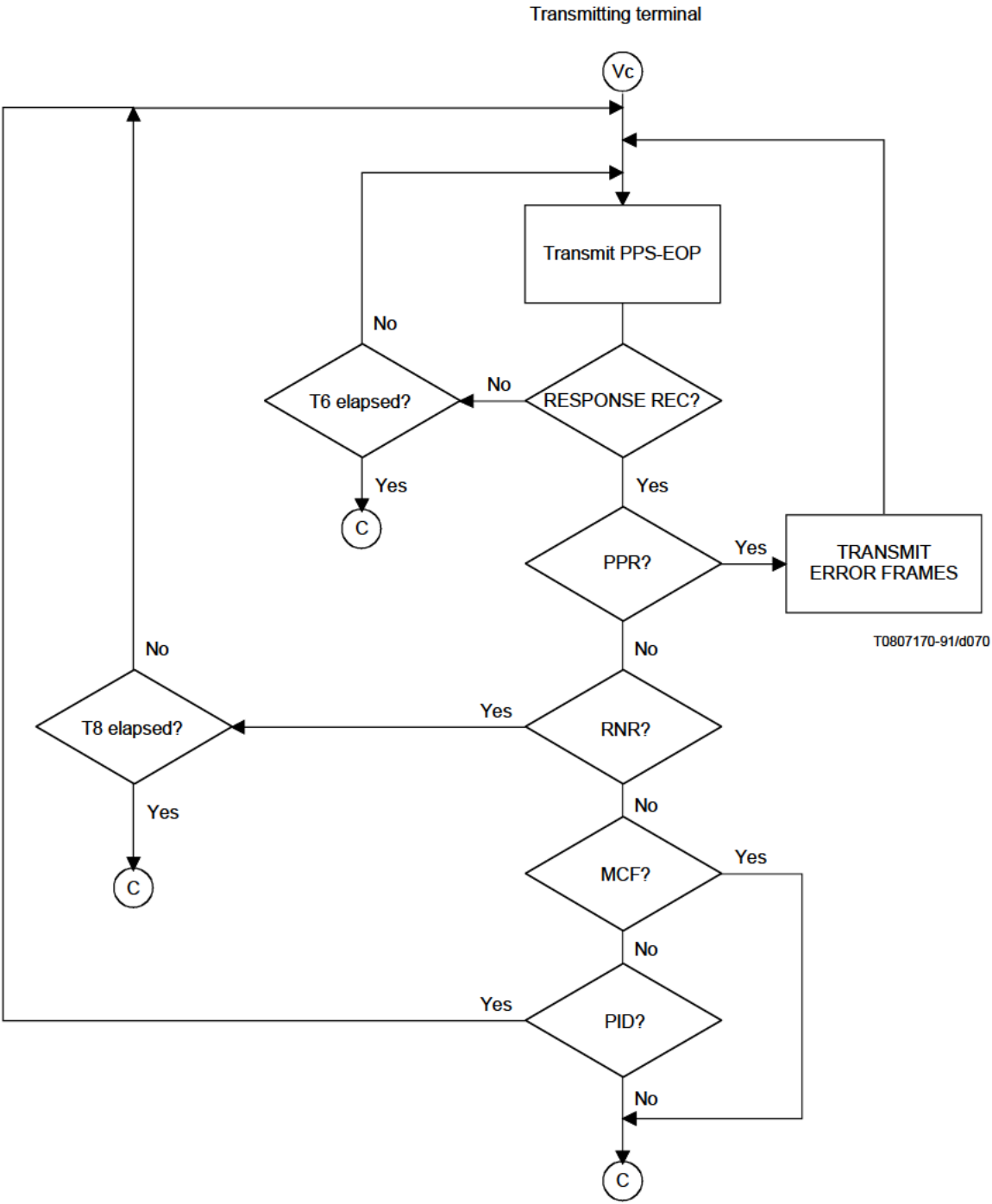


Figure C.17/T.30

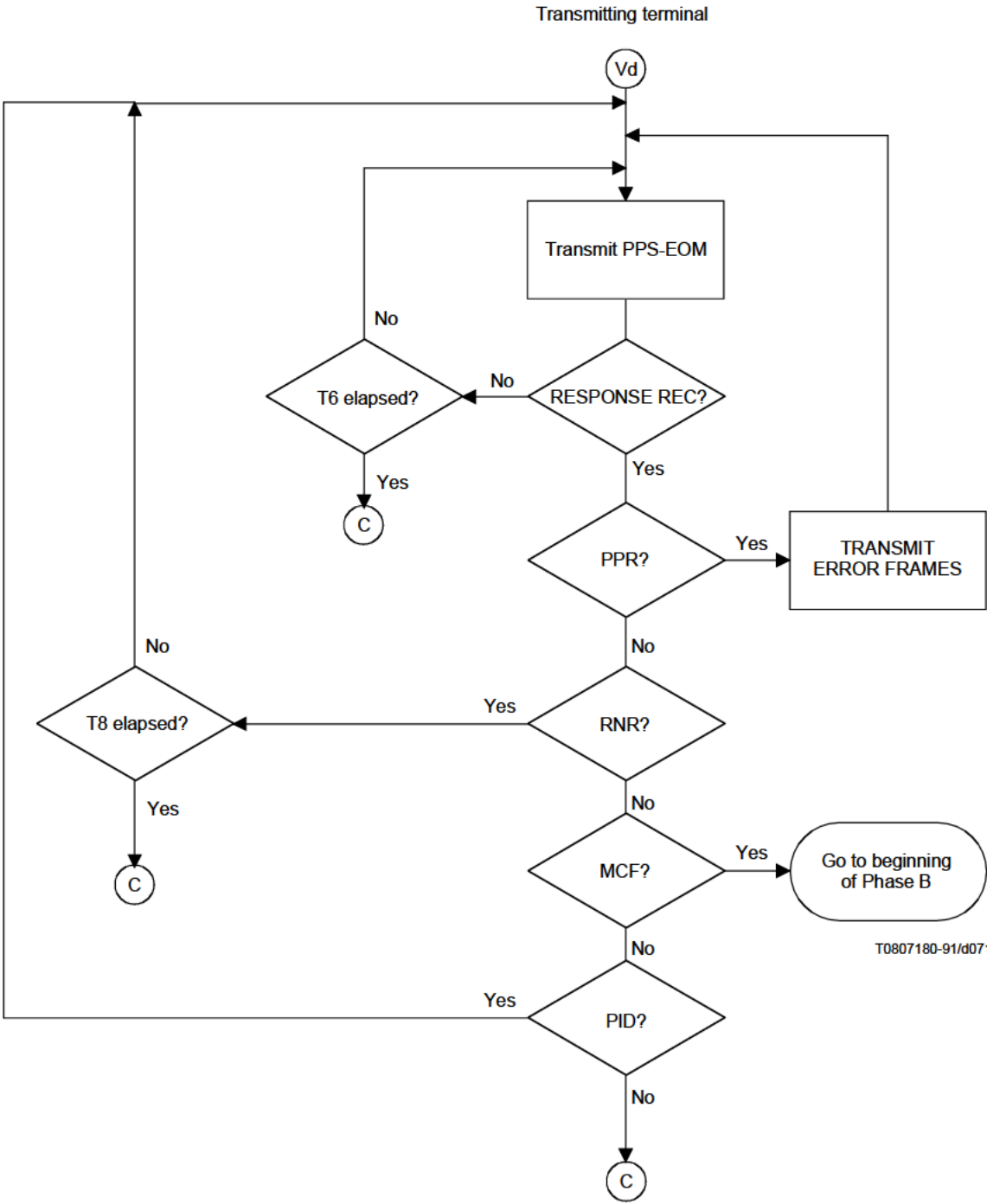


Figure C.18/T.30

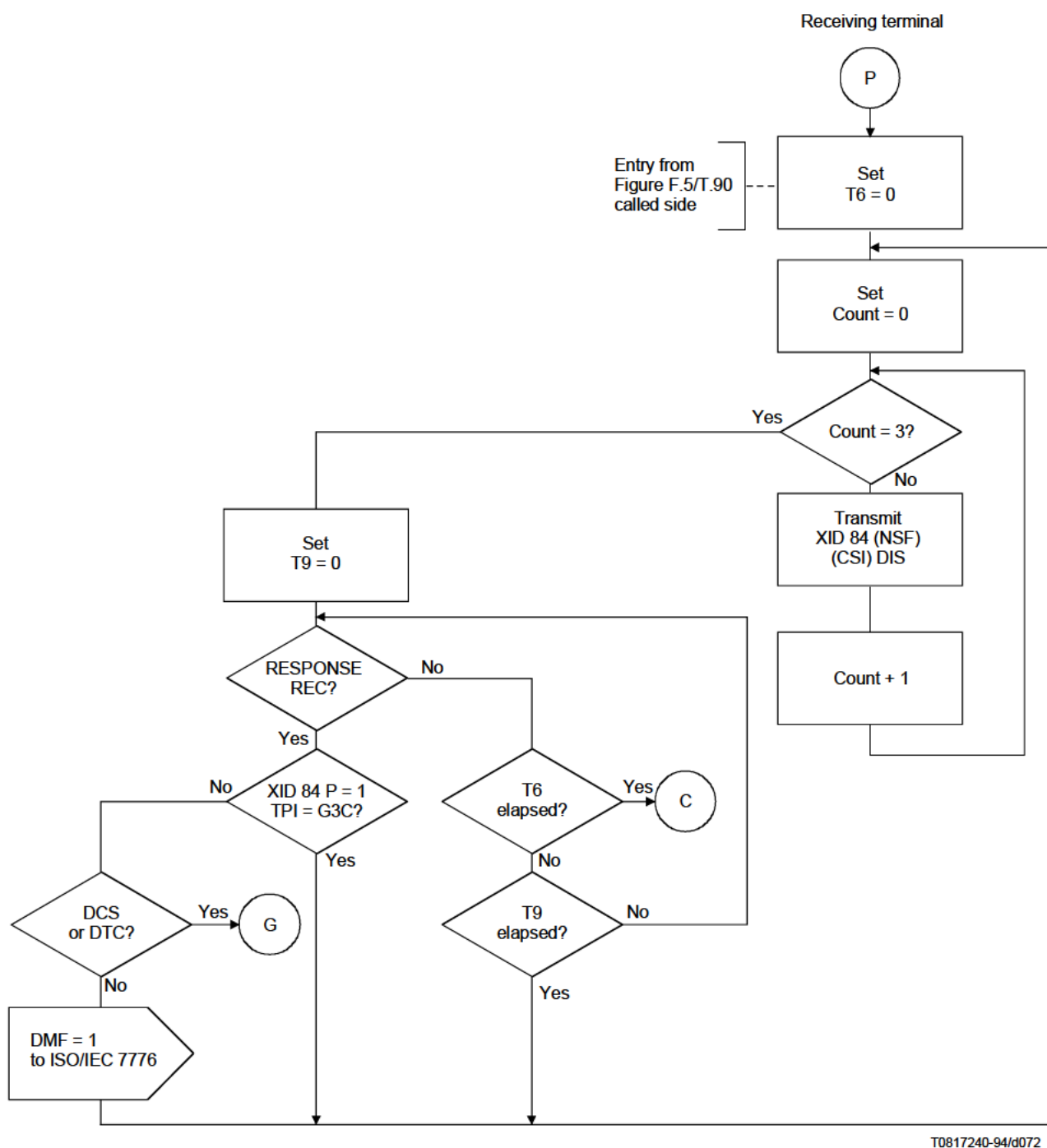


Figure C.19/T.30

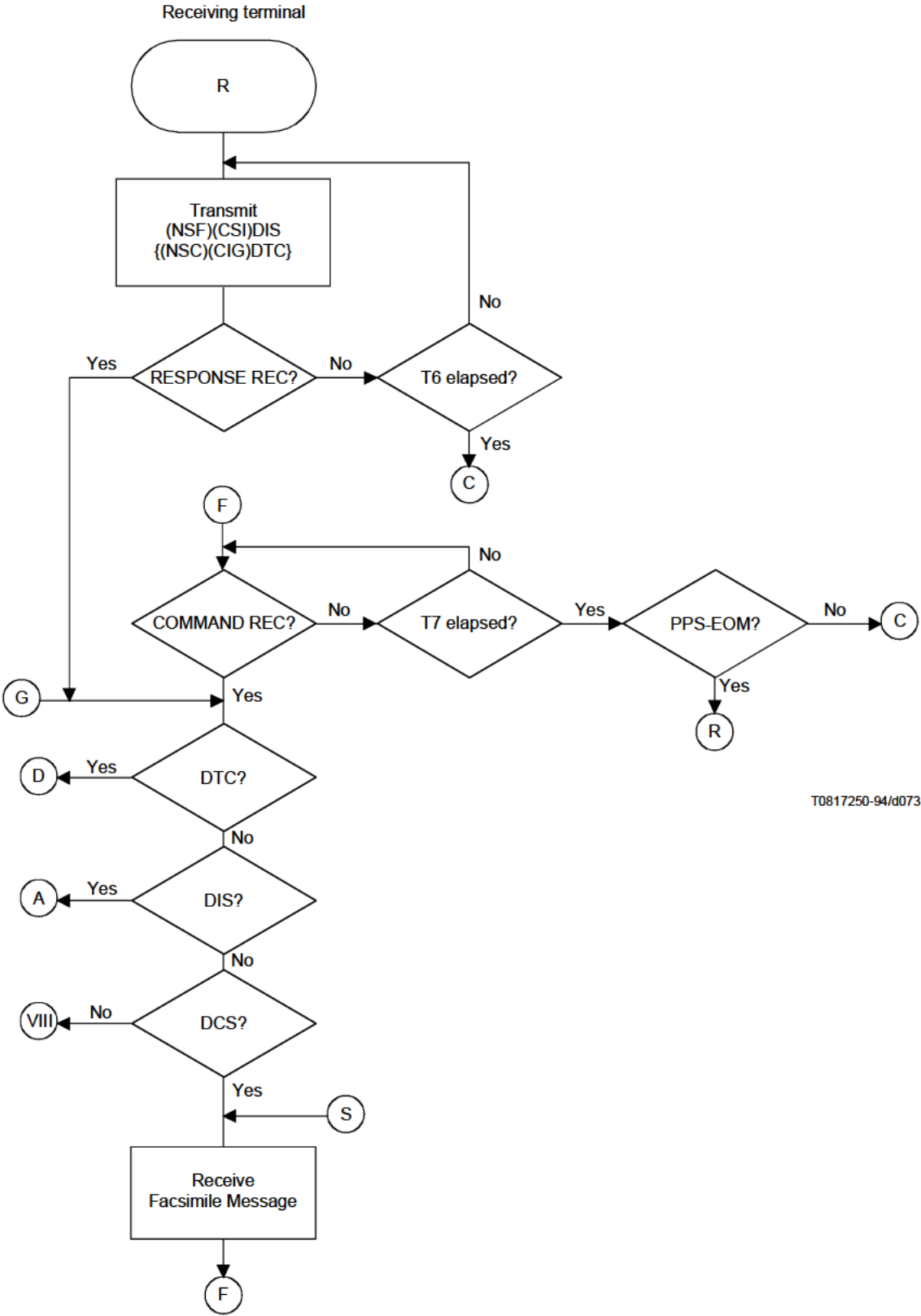


Figure C.20/T.30

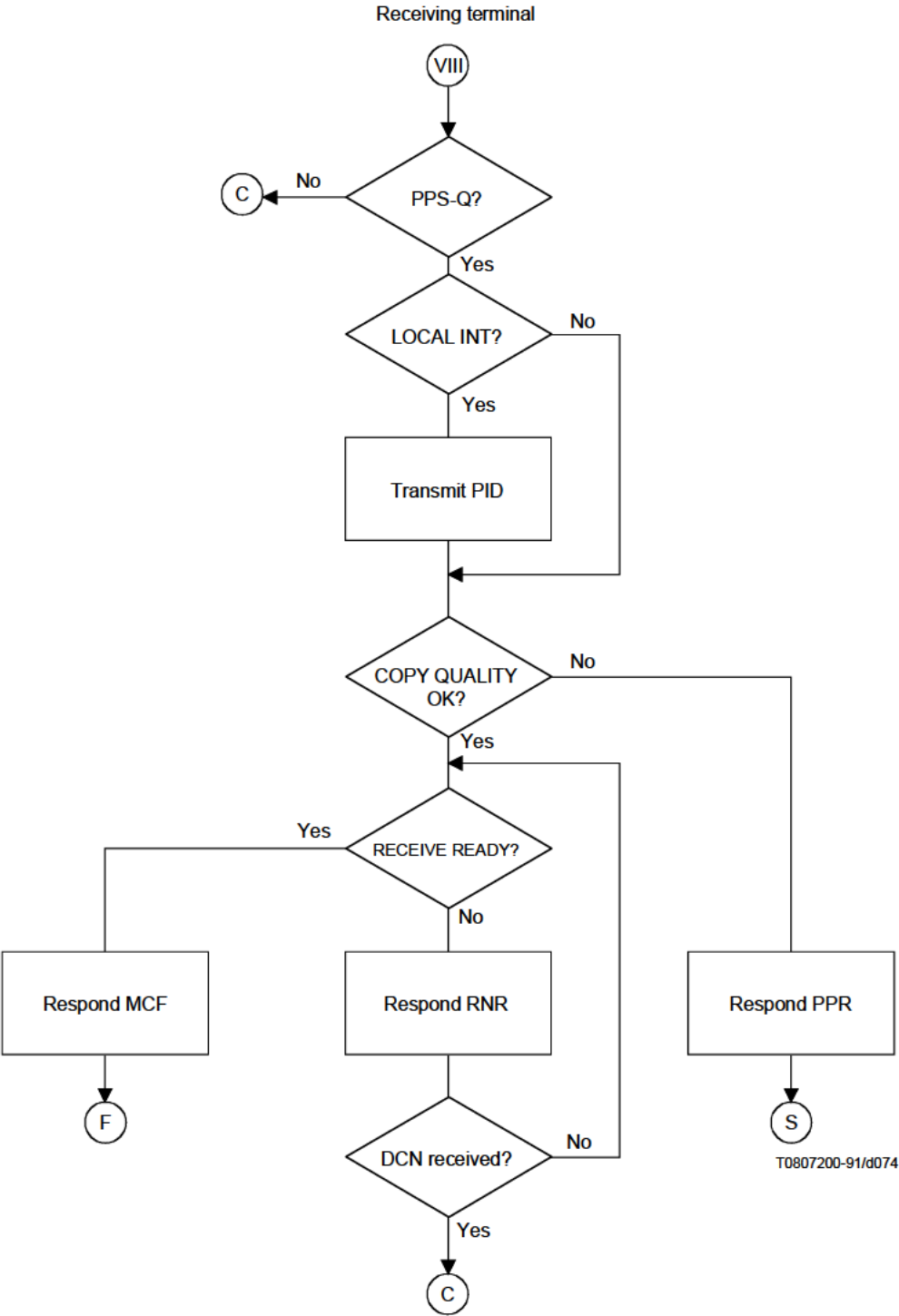
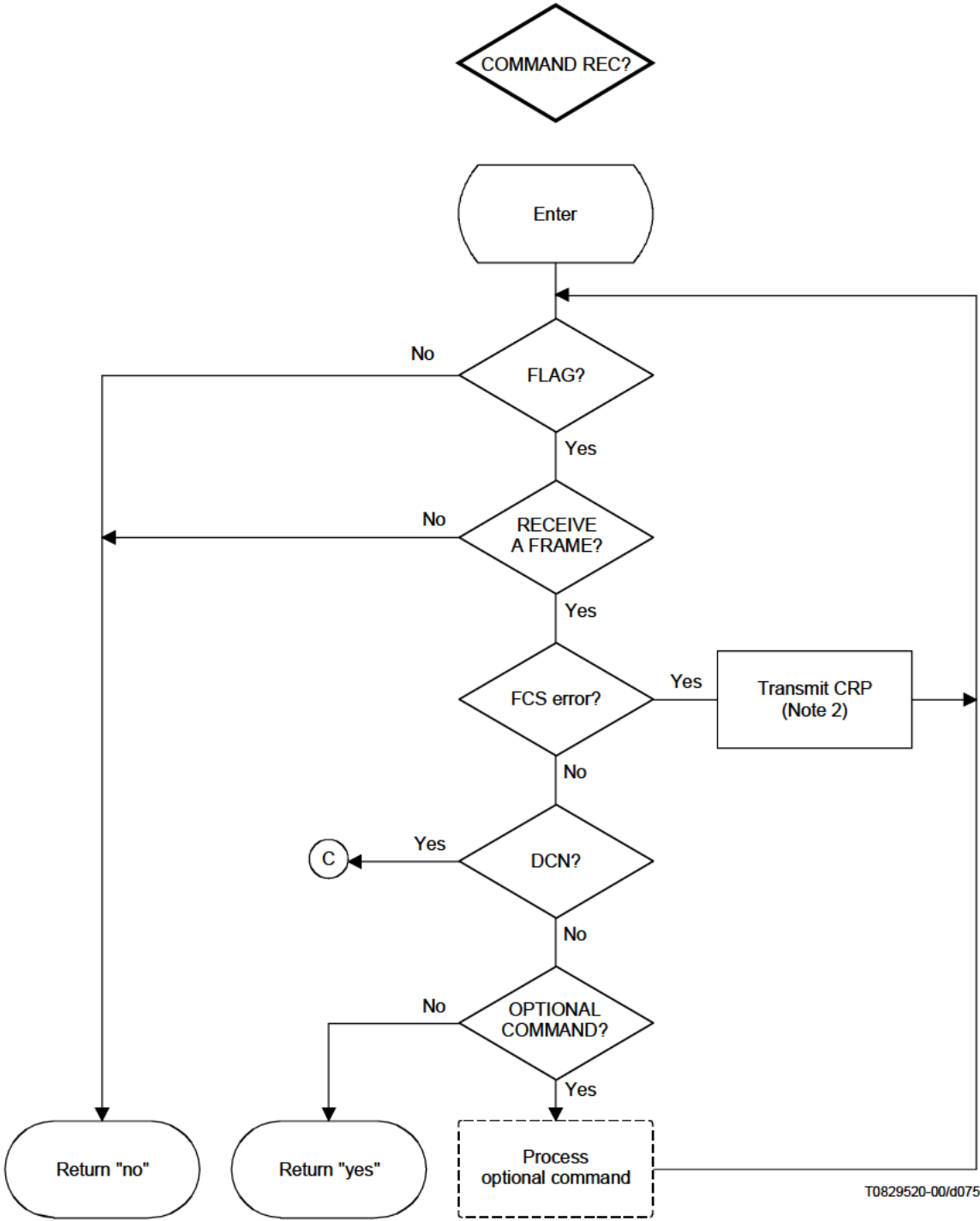


Figure C.21/T.30



T0829520-00/d075

Figure C.22/T.30

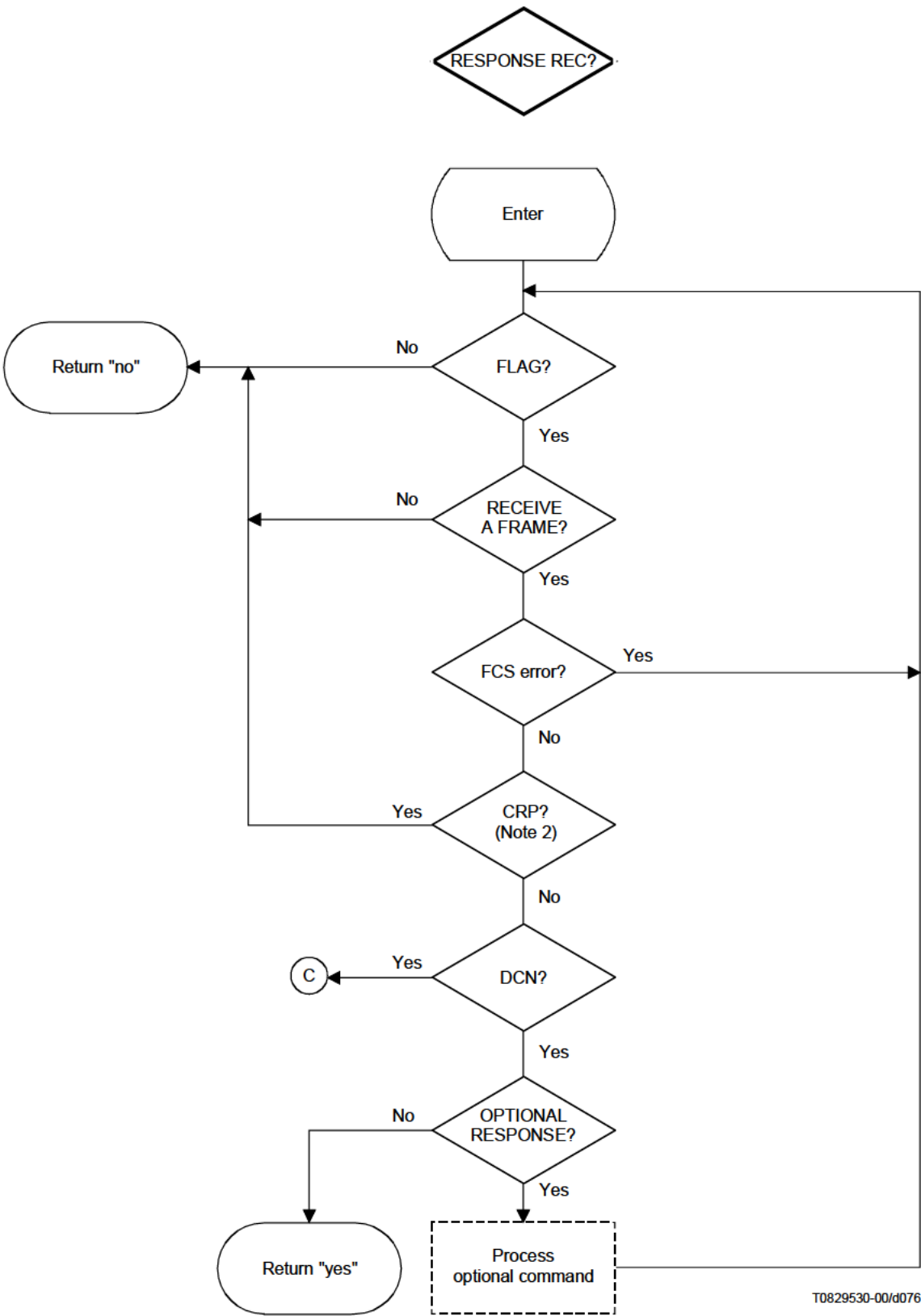


Figure C.23/T.30

C.6 Signal sequence examples

C.6.1 Duplex operation

The examples below (Figures C.24 to C.37) are based on the flow diagrams and are for illustrative and instructional purpose only. They should not be interpreted as establishing or limiting the protocol. The exchange of the various commands and responses is limited only by the rules specified in this Recommendation.

C.6.2 Half-duplex operation

The examples below (Figures C.38 to C.51) are based on the flow diagrams and are for illustrative and instructional purpose only. They should not be interpreted as establishing or limiting the protocol. The exchange of the various commands and responses is limited only by the rules specified in this Recommendation.

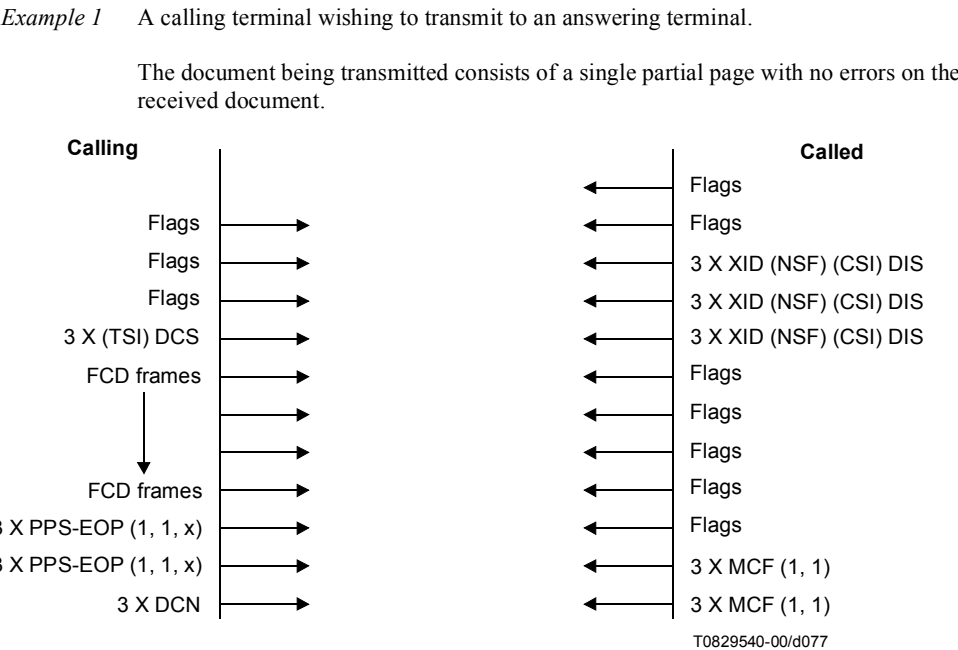


Figure C.24/T.30

Example 2 A calling terminal wishing to transmit to an answering terminal.

The document being transmitted consists of several partial pages with no errors on the received document.

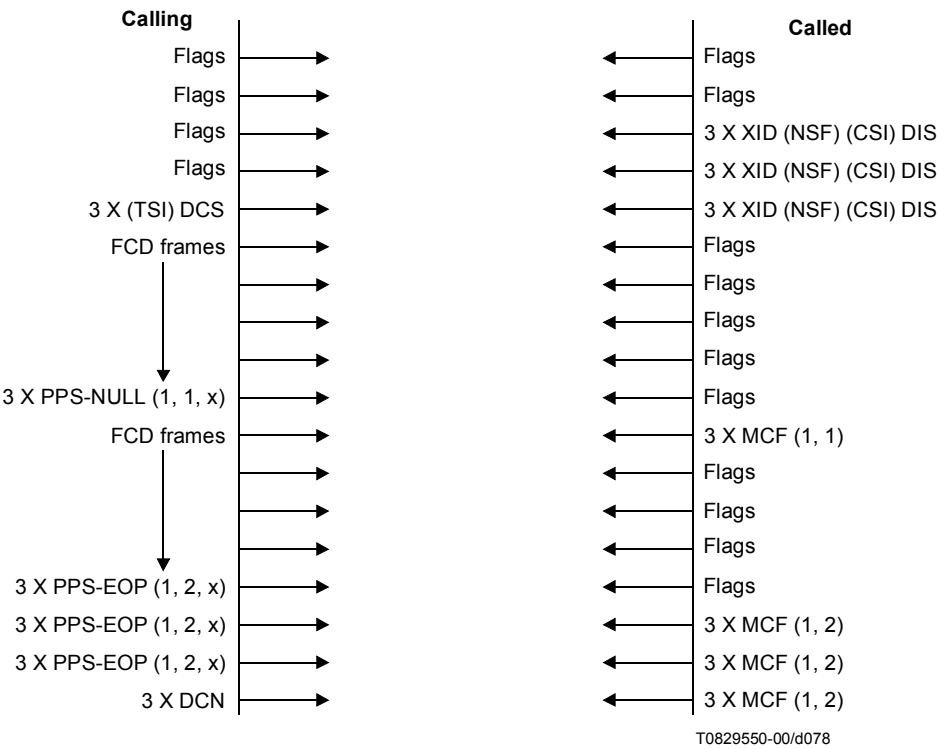


Figure C.25/T.30

Example 3 A calling terminal wishing to transmit to an answering terminal.

The document being transmitted consists of several partial pages with errors on the received document.

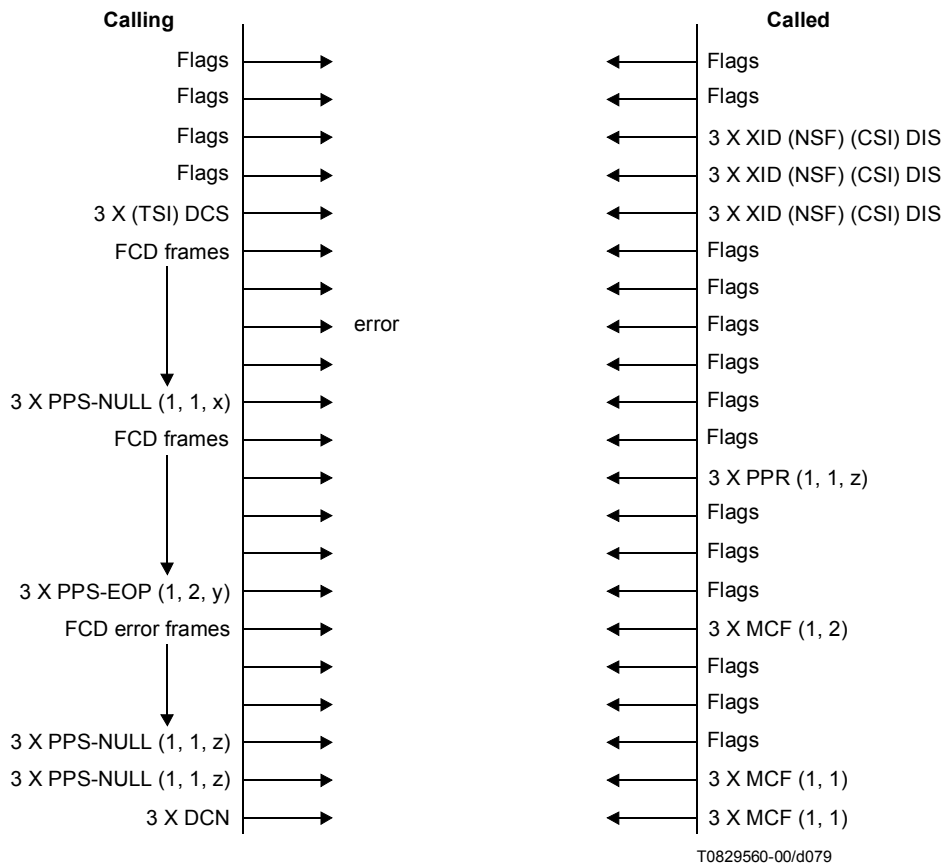


Figure C.26/T.30

Example 4 A calling terminal wishing to transmit to an answering terminal.

The document being transmitted consists of several partial pages with errors on the received document and errors on the corrections.

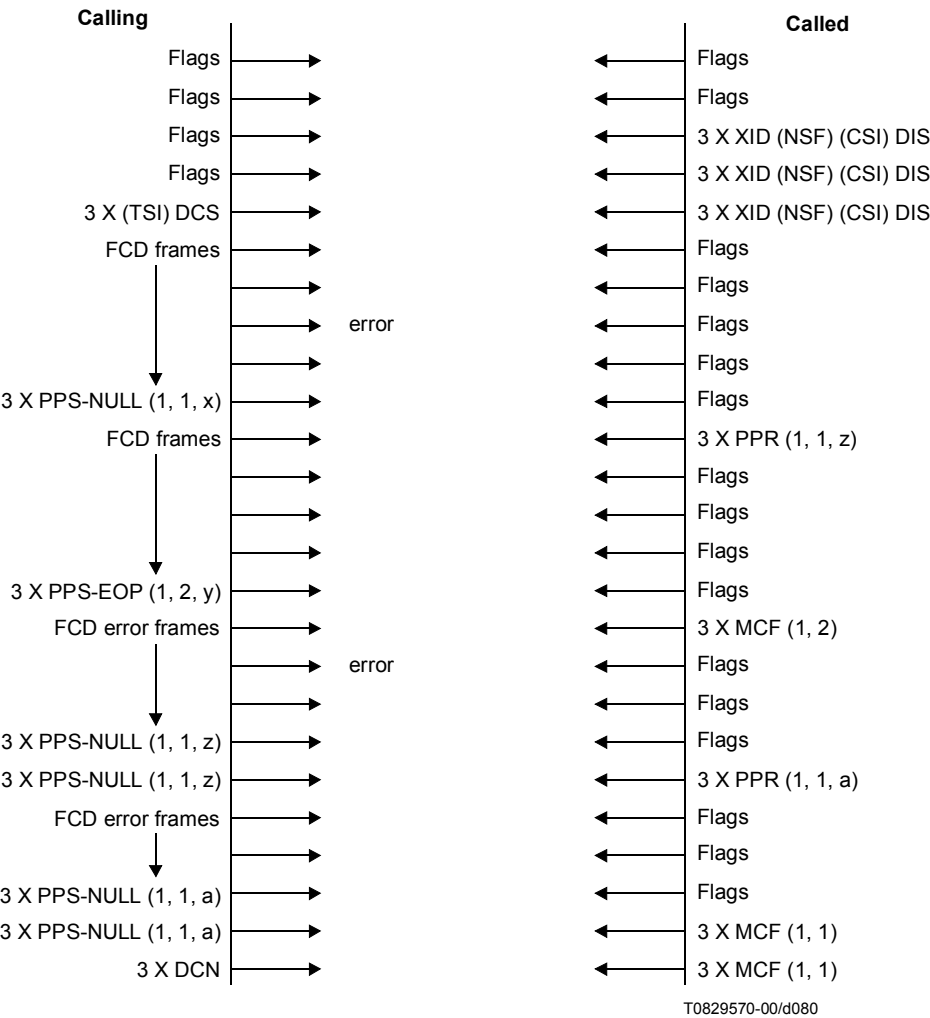


Figure C.27/T.30

Example 5 A calling terminal wishing to transmit to an answering terminal.

The document being transmitted consists of several partial pages with errors on a post-message command.

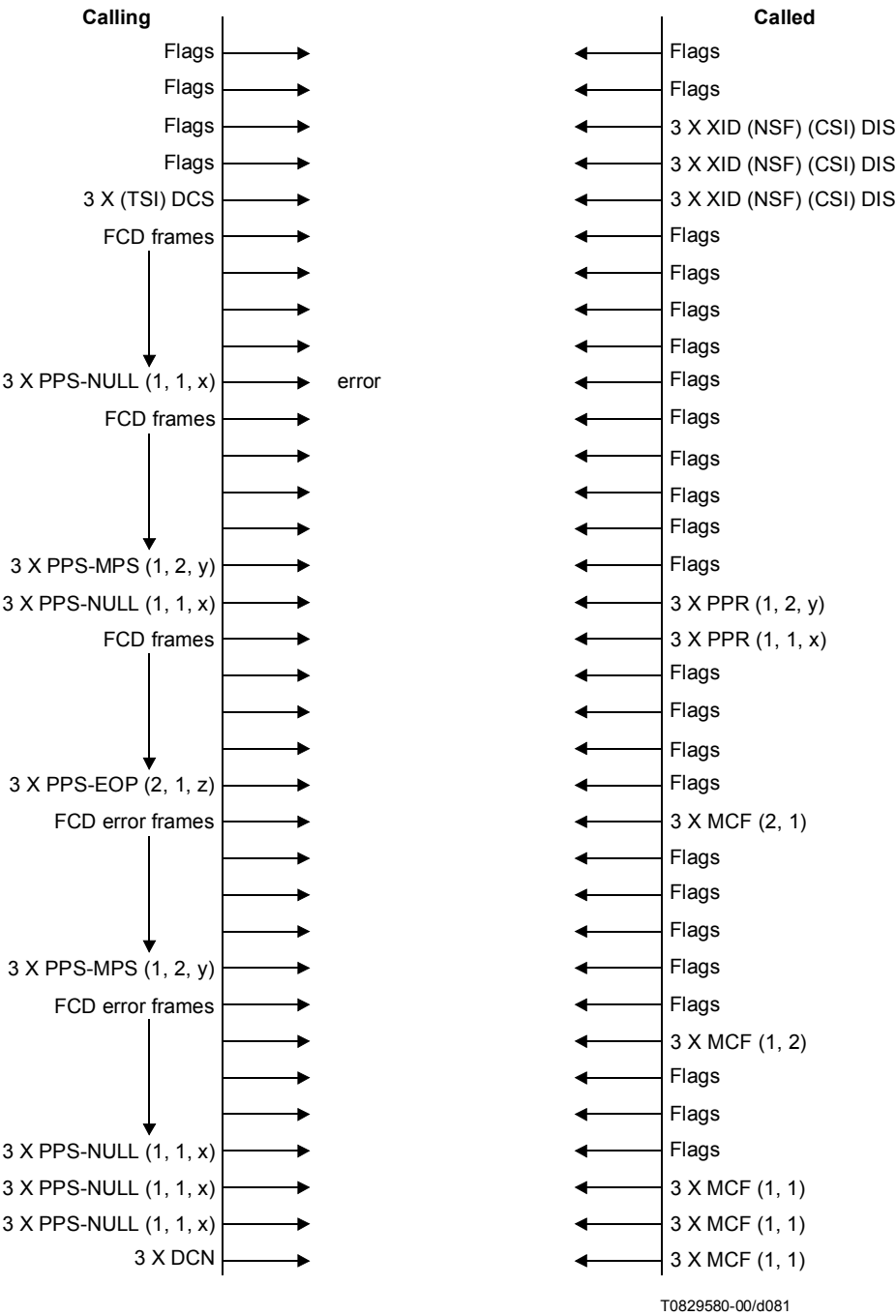


Figure C.28/T.30

Example 6 A calling terminal wishing to transmit to an answering terminal.

The document being transmitted consists of several partial pages with errors on the last post-message command.

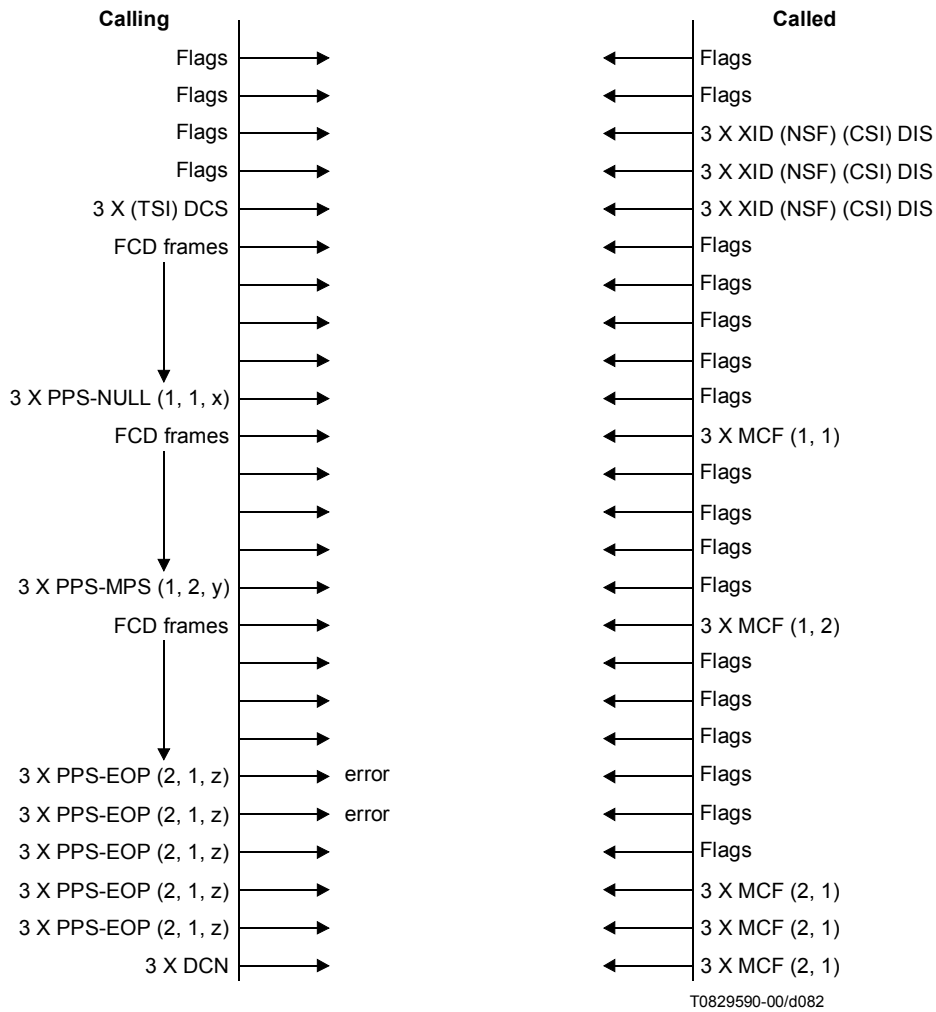


Figure C.29/T.30

Example 7 A calling terminal wishing to transmit to an answering terminal.

The document being transmitted consists of several partial pages with an error on the pre-message command.

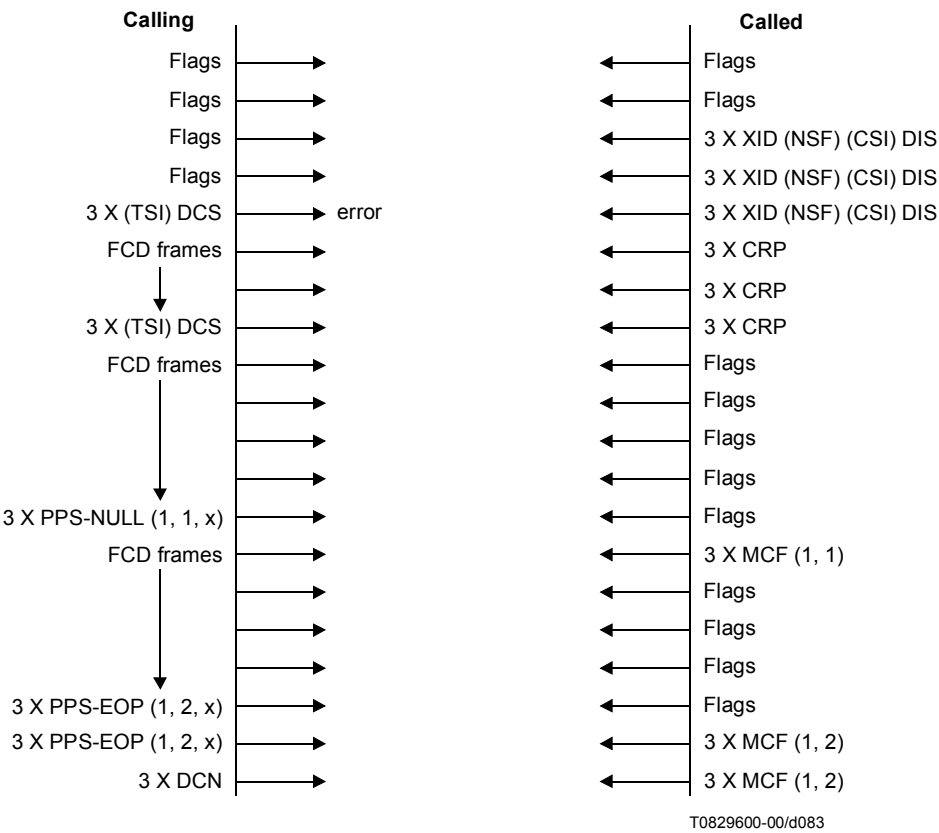


Figure C.30/T.30

Example 8 A calling terminal wishing to transmit to an answering terminal.

The document being transmitted consists of several partial pages with no response to the last post-message command.

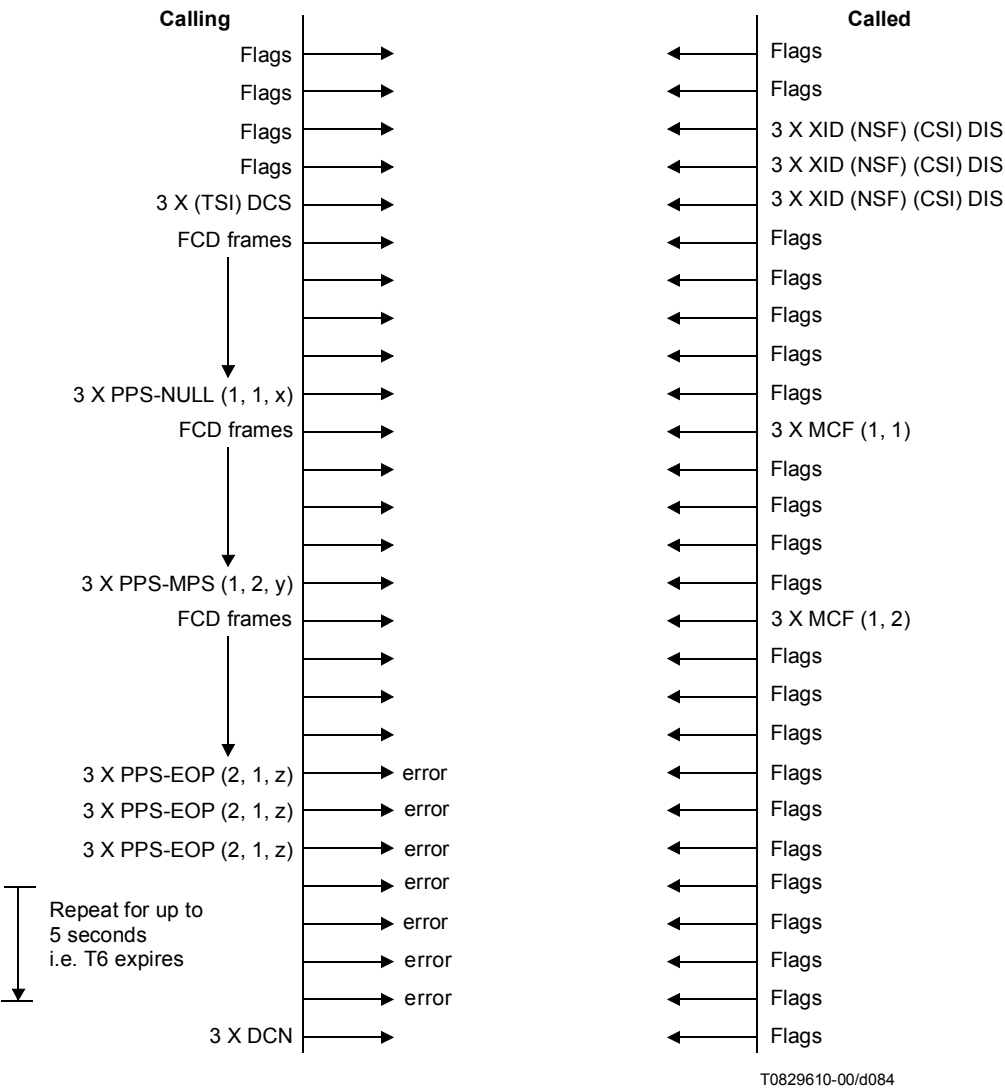


Figure C.31/T.30

Example 9 A calling terminal wishing to transmit to an answering terminal.

The document being transmitted consists of several partial pages with errors on the received document and receiver indicating it is not ready to receive new information.

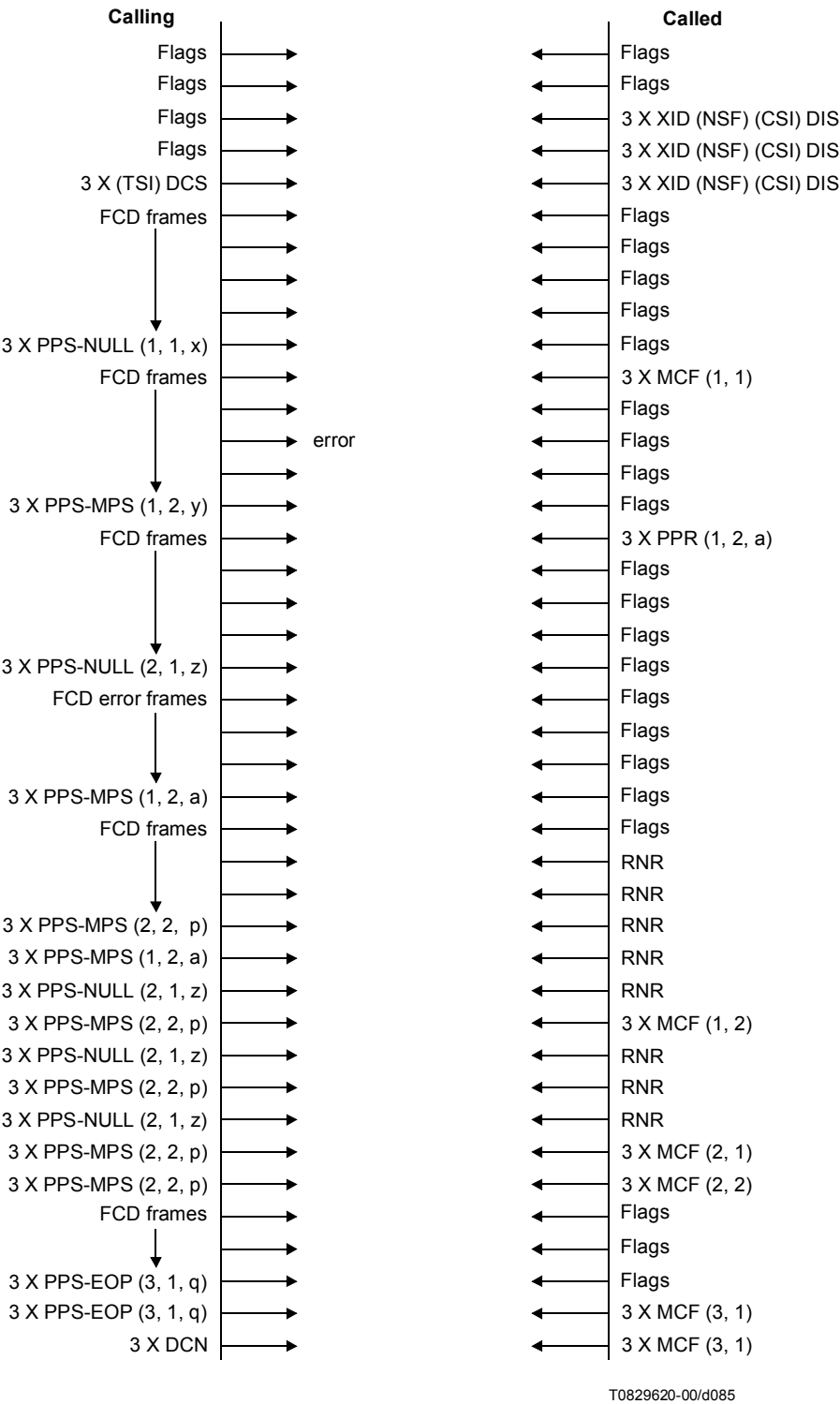


Figure C.32/T.30

Example 10 A calling terminal wishing to transmit to an answering terminal.

The document being transmitted consists of several partial pages with errors on the received document, receiver indicating it is not ready to receive new information and transmitter timing out.

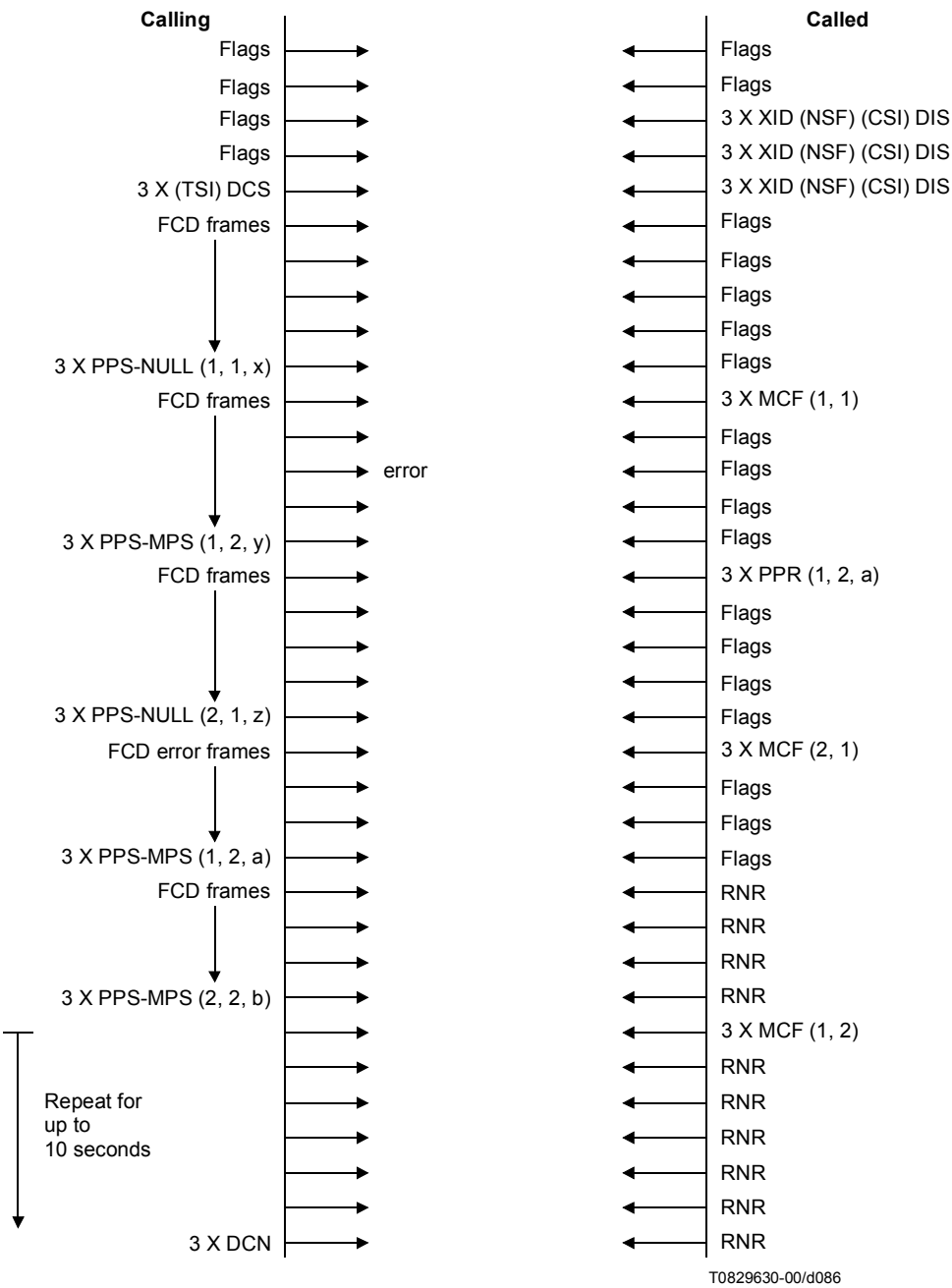


Figure C.33/T.30

Example 11 A calling terminal wishing to transmit to an answering terminal.

The document being transmitted consists of several partial pages with errors on the received document, receiver indicating it cannot receive any new information.

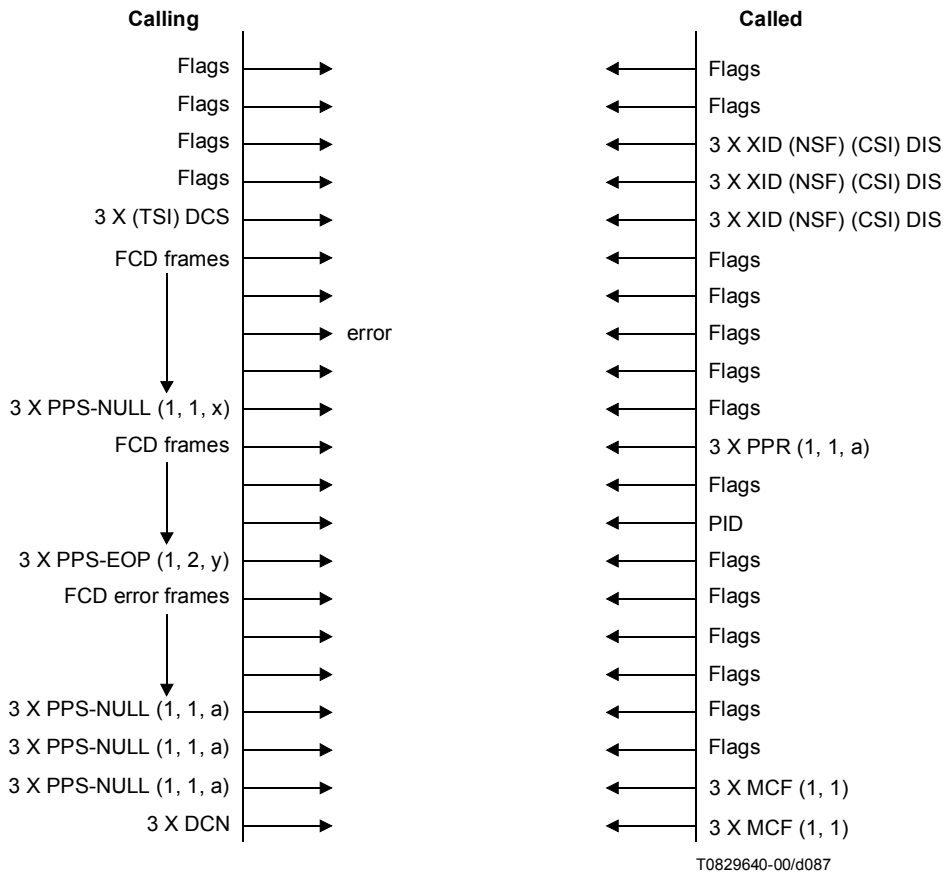


Figure C.34/T.30

Example 12 A calling terminal wishing to transmit to an answering terminal.

The calling terminal receives no recognizable signals from the called terminal and times out.

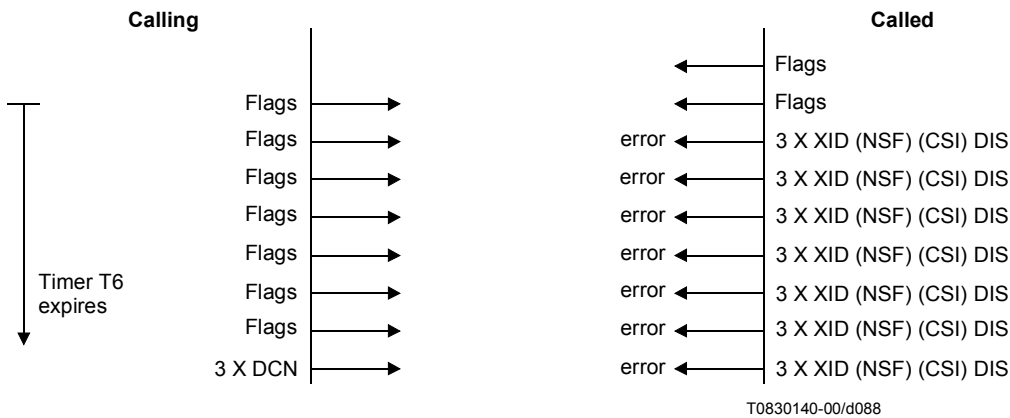


Figure C.35/T.30

Example 13 A calling terminal wishing to receive from an answering terminal.

The called terminal receives no recognizable signals from the calling terminal and times out.

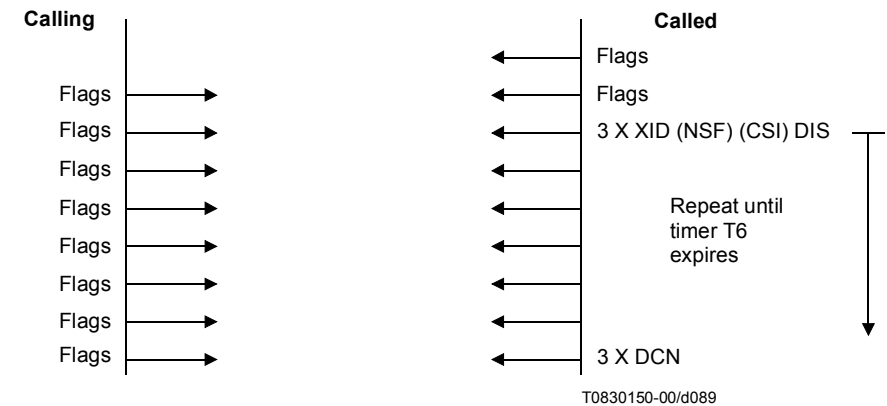


Figure C.36/T.30

Example 14 A calling terminal wishing to receive from an answering terminal.

The document being transmitted consists of a single partial page with no errors on the received document.

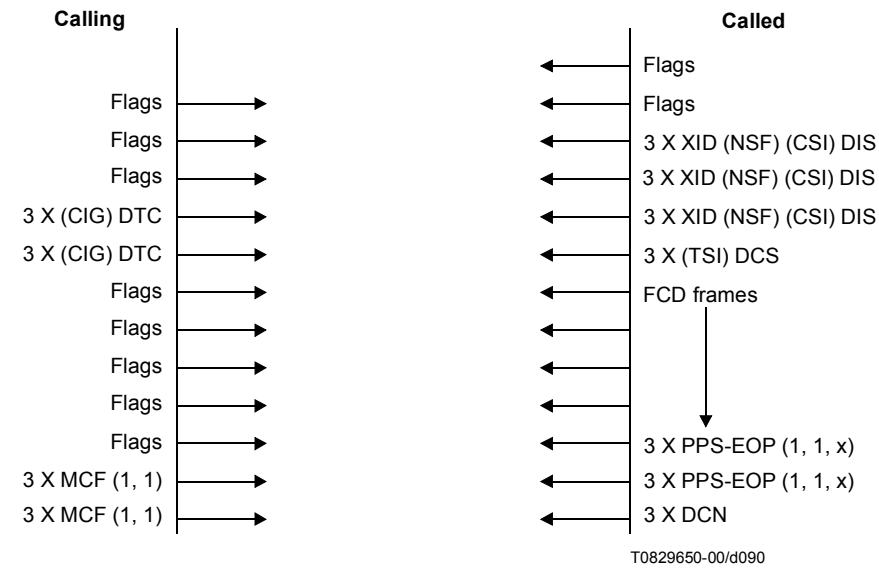


Figure C.37/T.30

Example 1 A calling terminal wishing to transmit to an answering terminal.

The document being transmitted consists of a single partial page with no errors on the received document.

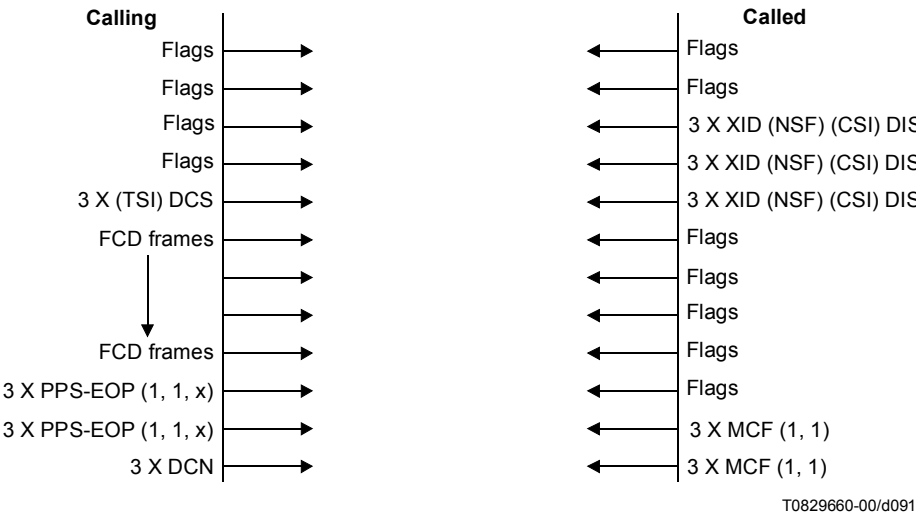


Figure C.38/T.30

Example 2 A calling terminal wishing to transmit to an answering terminal.

The document being transmitted consists of several partial pages with no errors on the received document.

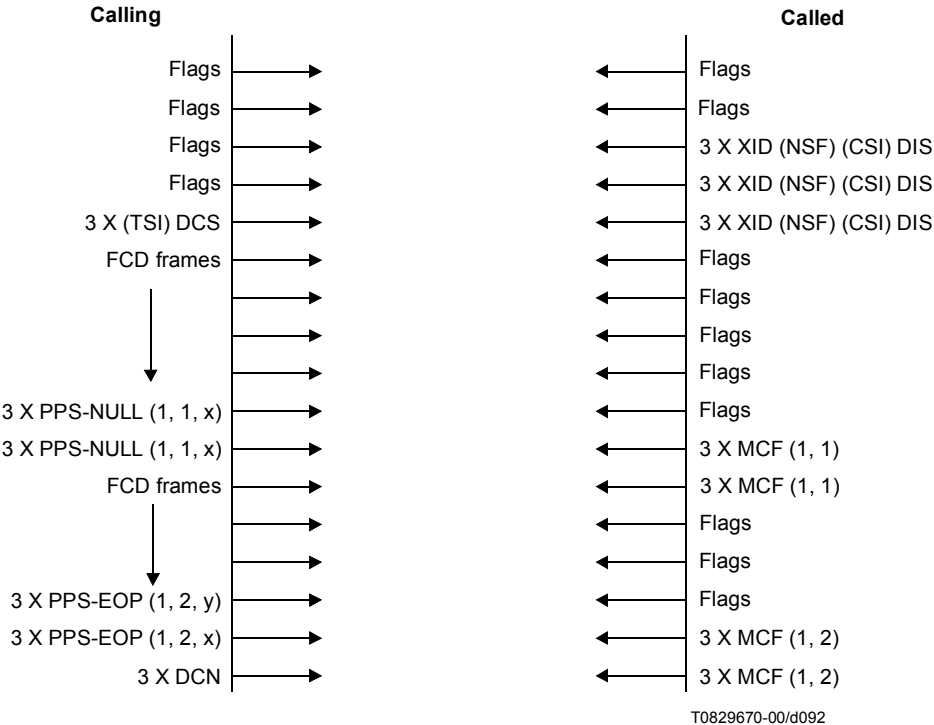


Figure C.39/T.30

Example 3 A calling terminal wishing to transmit to an answering terminal.

The document being transmitted consists of several partial pages with errors on the received document.

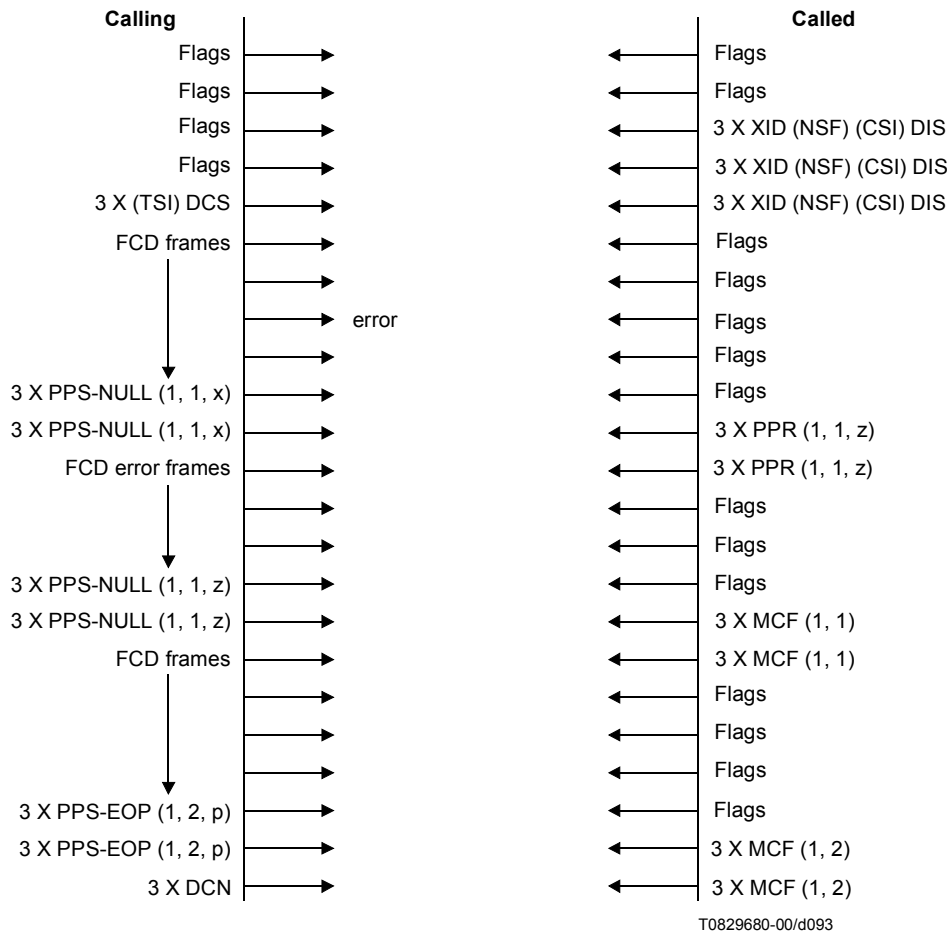


Figure C.40/T.30

Example 4 A calling terminal wishing to transmit to an answering terminal.

The document being transmitted consists of several partial pages with errors on the received document and errors on the corrections.

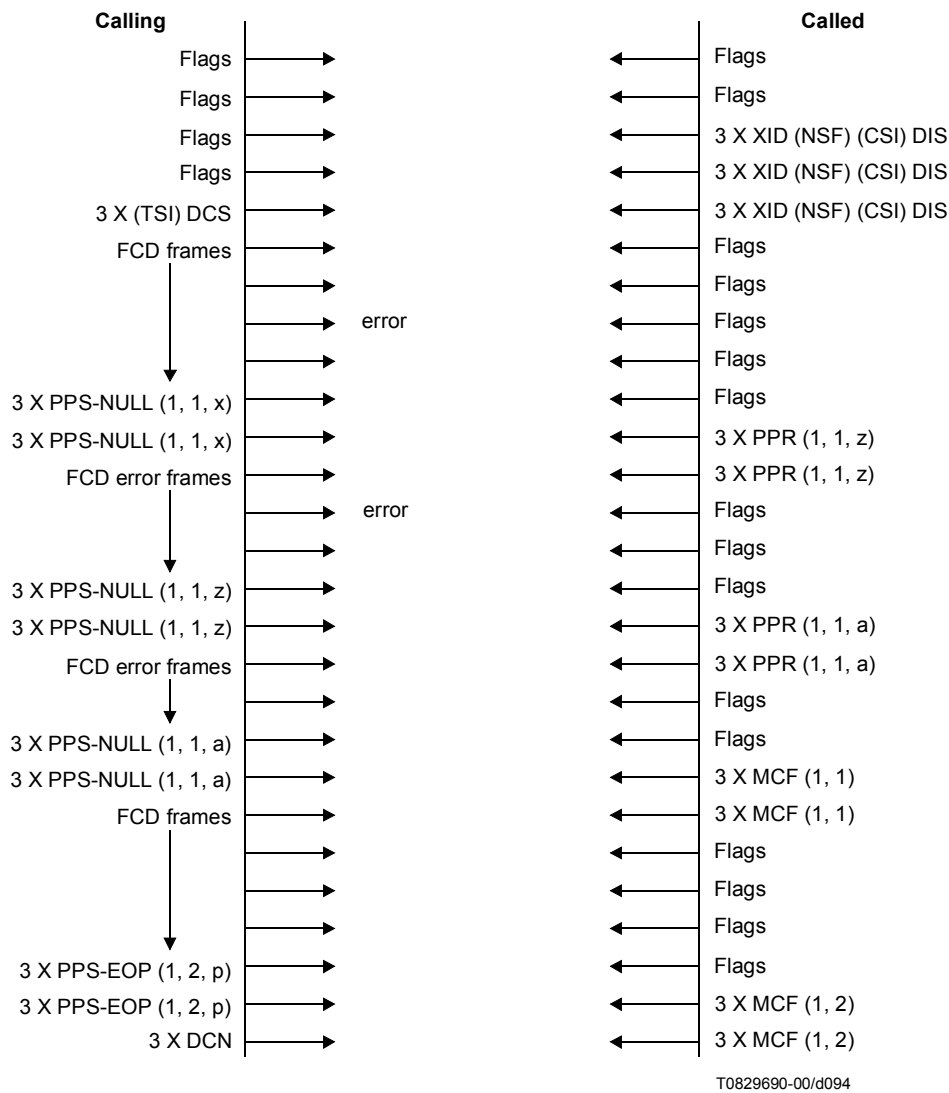


Figure C.41/T.30

Example 5 A calling terminal wishing to transmit to an answering terminal.

The document being transmitted consists of several partial pages with errors on a post-message command.

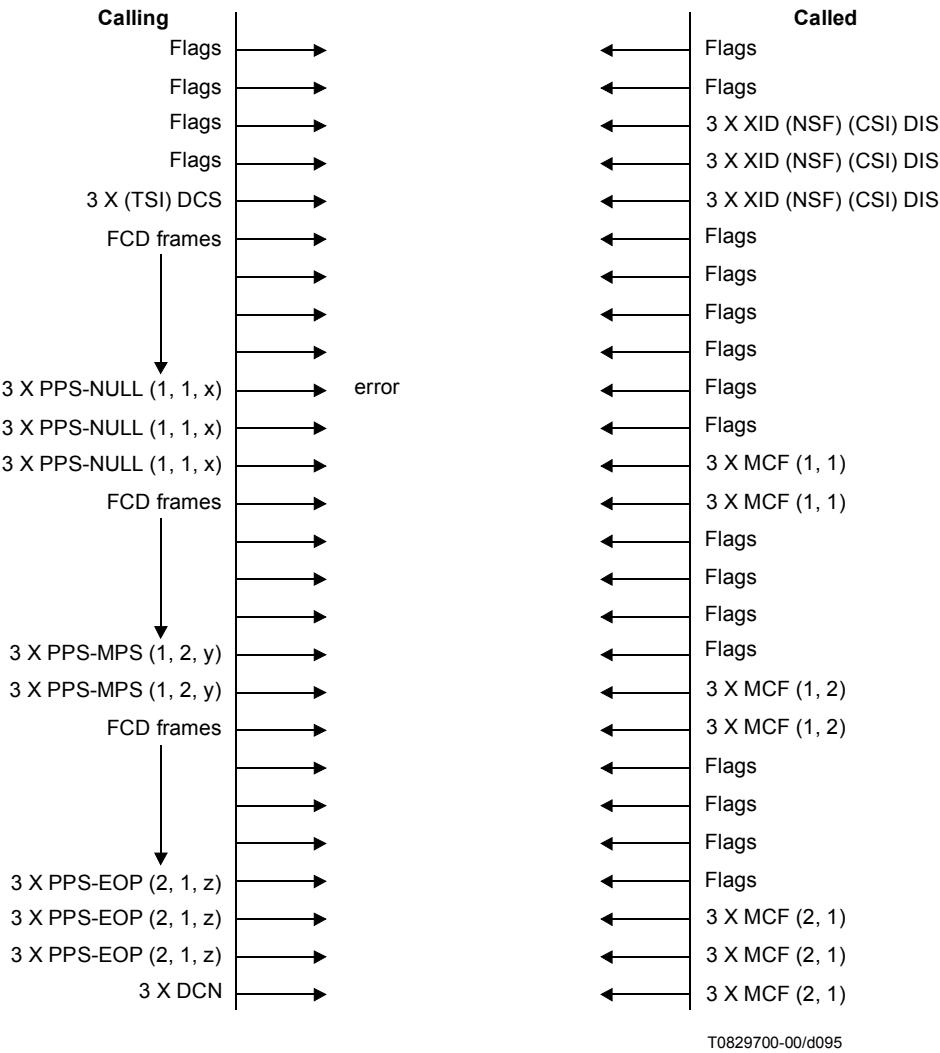


Figure C.42/T.30

Example 6 A calling terminal wishing to transmit to an answering terminal.

The document being transmitted consists of several partial pages with errors on the last post-message command.

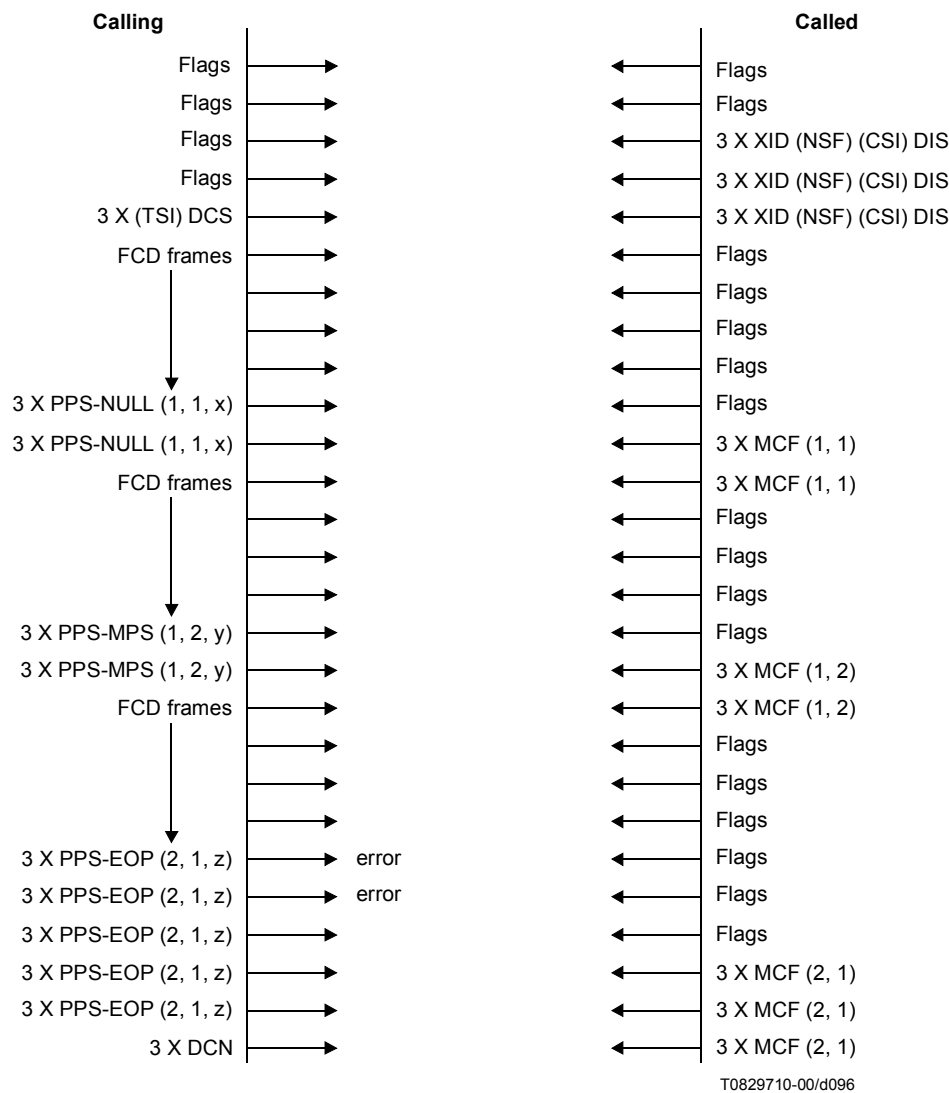


Figure C.43/T.30

Example 7 A calling terminal wishing to transmit to an answering terminal.

The document being transmitted consists of several partial pages with an error on the pre-message command.

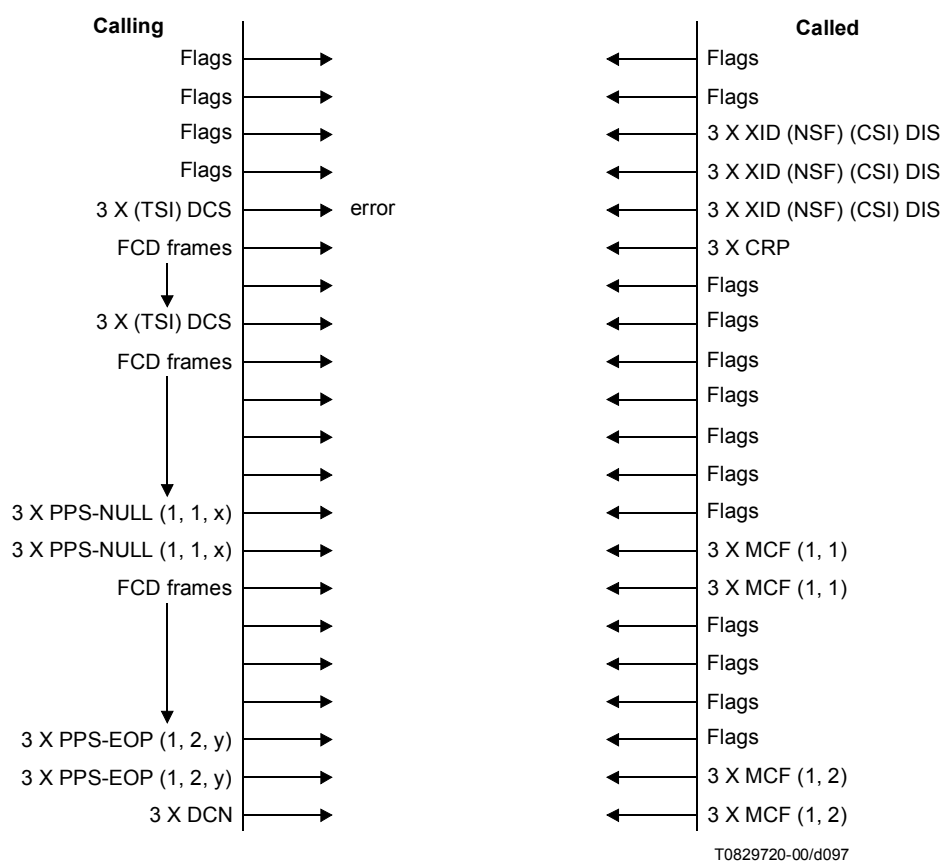


Figure C.44/T.30

Example 8 A calling terminal wishing to transmit to an answering terminal.

The document being transmitted consists of several partial pages with no response to the last post-message command.

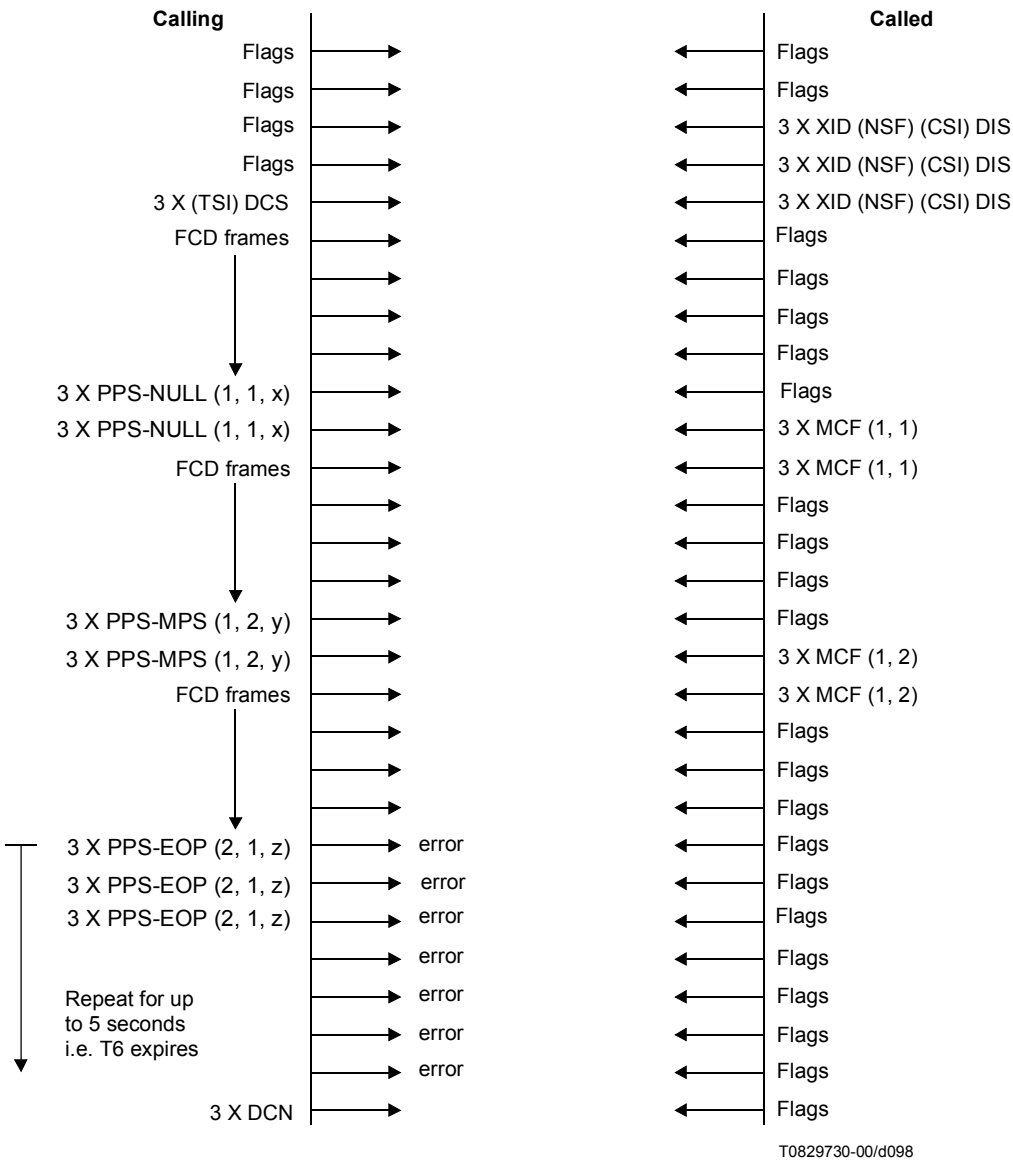


Figure C.45/T.30

Example 9 A calling terminal wishing to transmit to an answering terminal.

The document being transmitted consists of several partial pages with errors on the received document and receiver indicating it is not ready to receive new information.

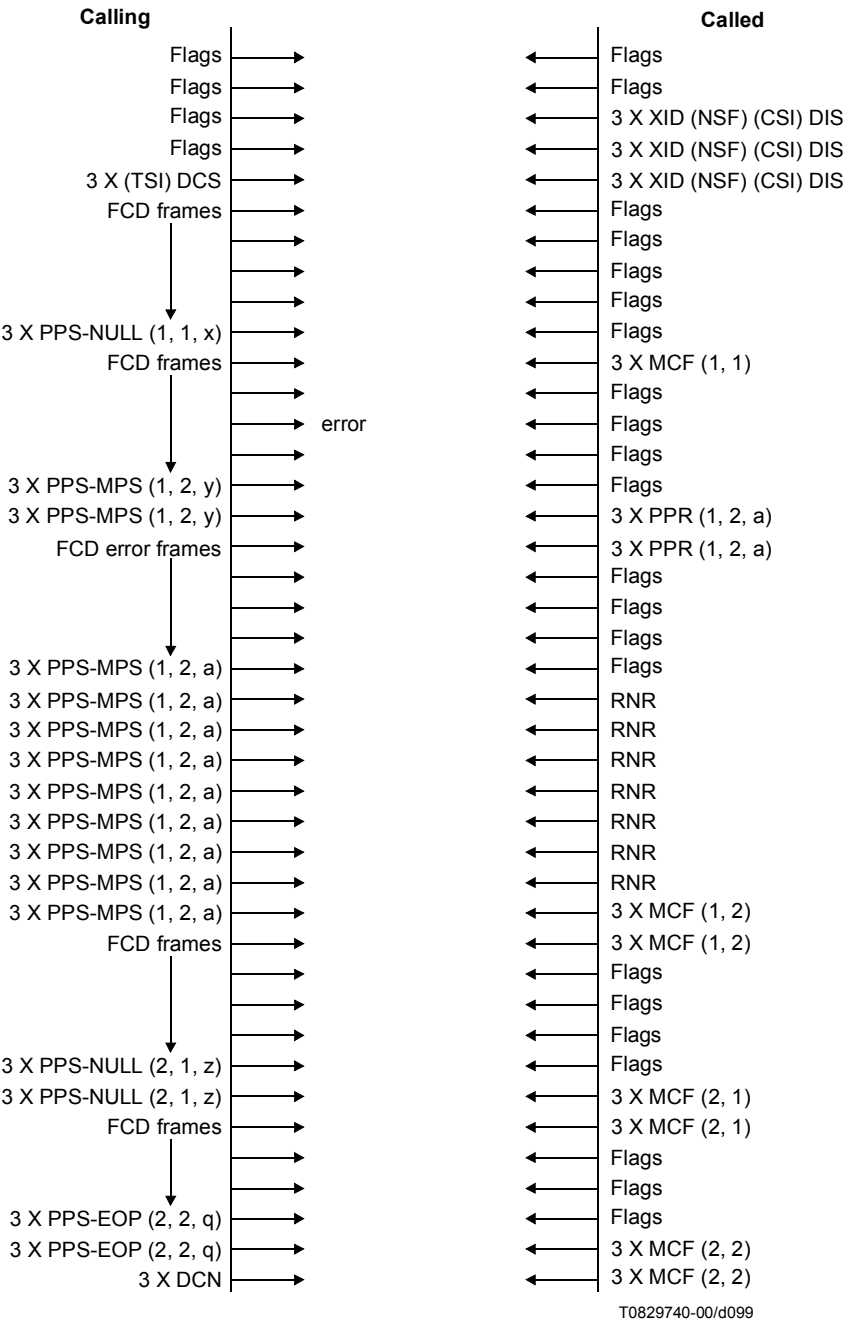


Figure C.46/T.30

Example 10 A calling terminal wishing to transmit to an answering terminal.

The document being transmitted consists of several partial pages with errors on the received document, receiver indicating it is not ready to receive new information and transmitter timing out.

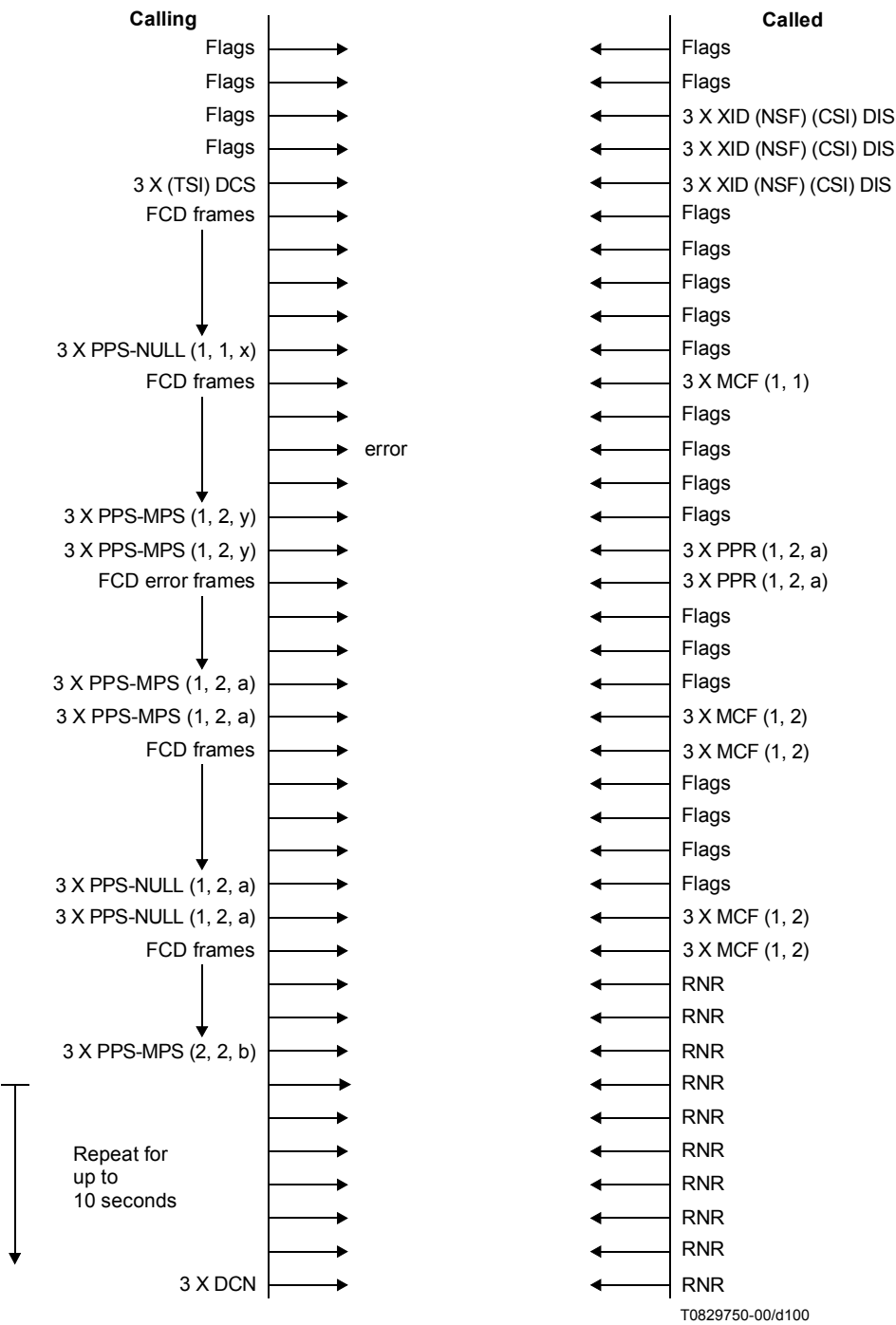


Figure C.47/T.30

Example 11 A calling terminal wishing to transmit to an answering terminal.

The document being transmitted consists of several partial pages with errors on the received document, receiver indicating it cannot receive any new information.

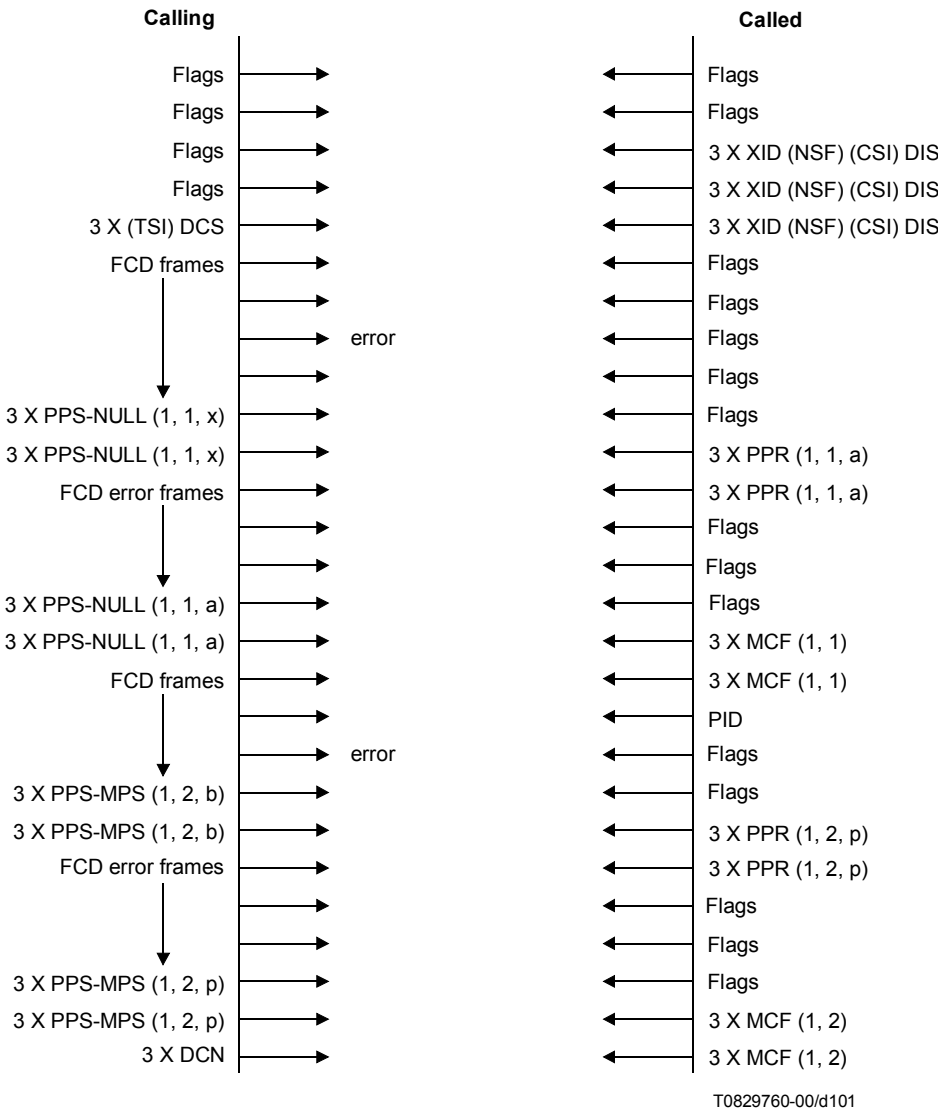


Figure C.48/T.30

Example 12 A calling terminal wishing to transmit to an answering terminal.

The calling terminal receives no recognizable signals from the called terminal and times out.

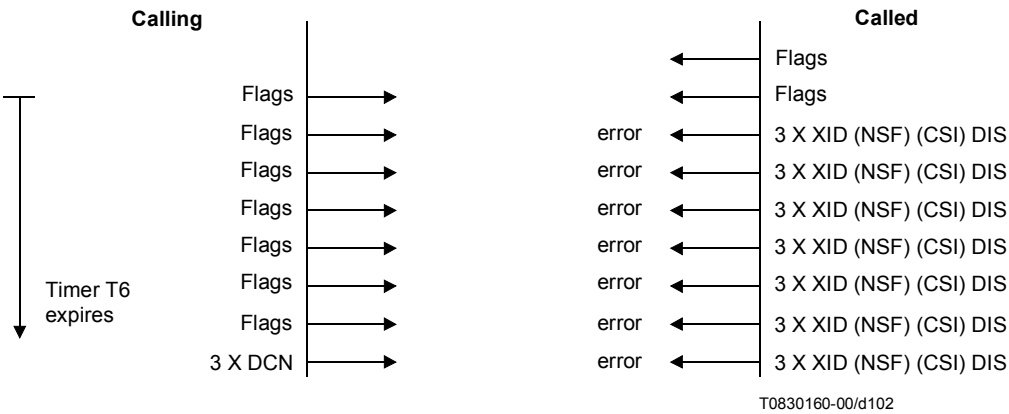


Figure C.49/T.30

Example 13 A calling terminal wishing to transmit to an answering terminal.

The called terminal receives no recognizable signals from the calling terminal and times out.

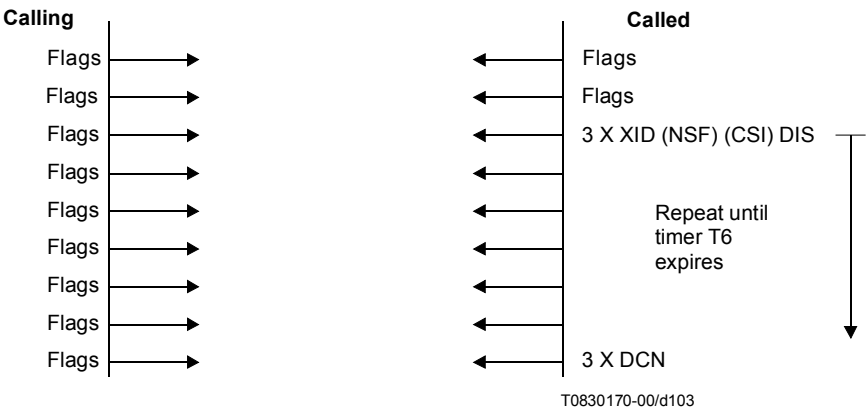


Figure C.50/T.30

Example 14 A calling terminal wishing to receive from an answering terminal.

The document being transmitted consists of a single partial page with no errors on the received document.

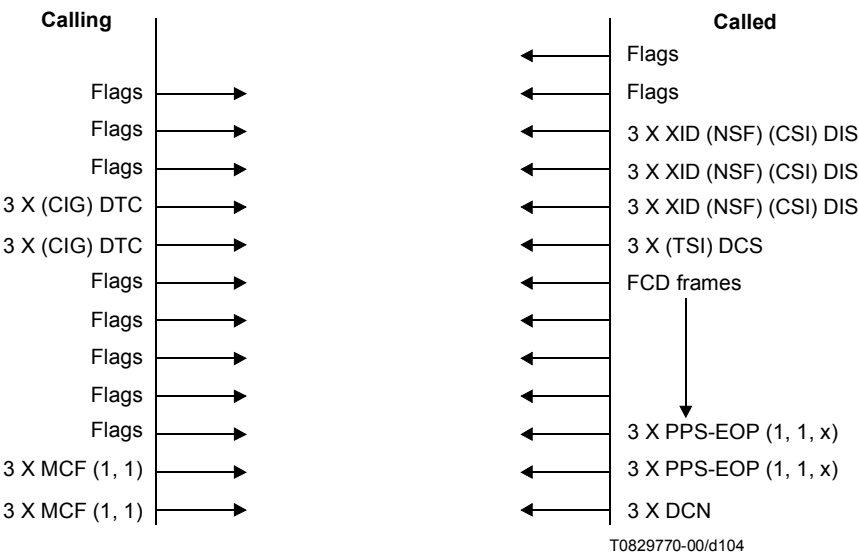


Figure C.51/T.30

C.7 Procedures for using Annex C within analog transmission environments

This clause describes the use of Annex C procedures when a prior data path has been established between two facsimile terminals by means other than those described in Phases A and B of this Recommendation.

C.7.1 Frame size

The called terminal should be able to support 64 octet frames in addition to 256 octet frames. This capability will be indicated by setting DIS/DTC bit 7 to "1". The calling terminal shall honour a called terminal's request for 64 octet frames and respond by setting bit 28 of the DCS to "1".

C.7.2 DIS/DTC/DCS indications

When the Annex C procedures are used in the analog transmission mode, bit 66 shall be set to "0".

C.7.3 Use of XID

The User Data Subfield (UDS) of the XID information field may be employed to indicate the data rates to be used in transmission over the channel.

C.7.4 Timers

When Annex C procedures are used with analog transmission rates less than 32 kbit/s, the values for T6 and T8 (see C.3.7.2.1) should be increased according to Table C.1.

Table C.1/T.30

Timer	Value and tolerance	Comment	Note
T6	35 ± 5 s	Annex C, terminal ID timer	1
T8	60 ± 5 s	Annex C, busy (no corrections and RNR) timer	2
NOTE 1 – In Annex C, timer T6 is functionally equivalent to timer T1 (see 5.4.3.1) and is given the same value.			
NOTE 2 – In Annex C, timer T8 is functionally equivalent to timer T5 (see 5.4.3.1) and is given the same value.			

Annex D

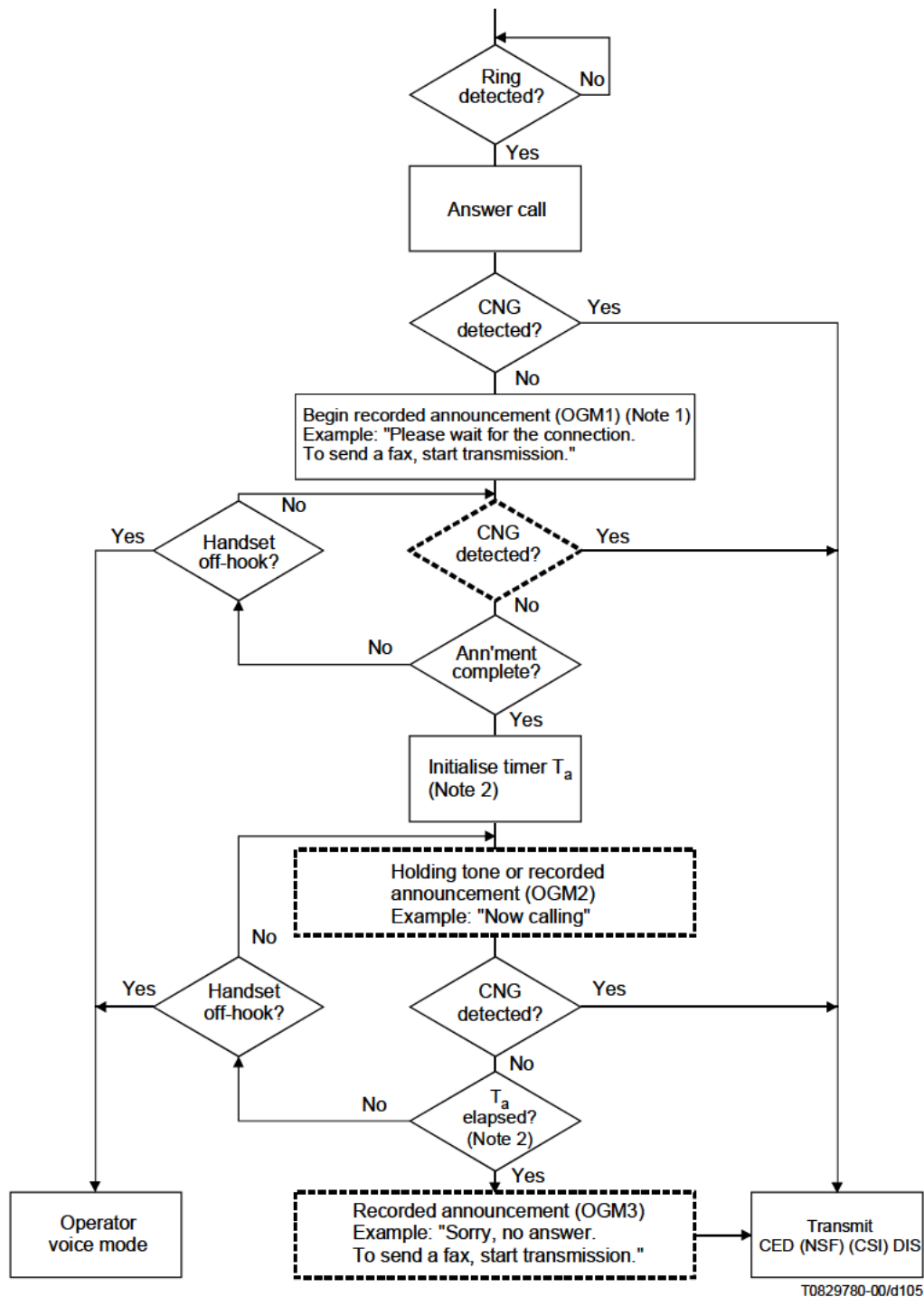
Optional automatic terminal selection procedures

This annex provides for optional automatic terminal selection procedures for two types of devices. Device 1 provides for selection between combined facsimile and telephone answering. Device 2 provides for selection between combined facsimile and telephone answering and recording device. Other terminal configurations are for further study.

Device 1: Combined facsimile and telephone answering

Full details of this procedure are defined in Figure D.1.

- 1) The called terminal shall attempt to detect CNG during the 1.8 to 2.5 seconds of quiet immediately after the called terminal is connected to the line.
- 2) Outgoing message (OGM1) shall be issued by the called terminal to inform the caller that the call has been answered and is being processed. An example of OGM1 follows: "Please wait, to start Fax begin transmission now".
At 1.8 to 2.5 seconds after the called terminal is connected to the line, it shall send OGM1 for a duration of not more than T_{OGM1} . The value of T_{OGM1} is for further study.
- 3) The called terminal may continue to detect CNG in parallel during OGM1.
- 4) A local operator at the called terminal may lift the handset off-hook at any point during this procedure, prior to detection of CNG.
- 5) CNG detection shall continue at the end of OGM1 if CNG was not detected earlier or local operator has not taken control of the call. The duration of this CNG detection is defined by T_a timer. Another OGM (OGM2) may be issued during this CNG detection period.
- 6) Fax signals shall be issued by the called terminal some time after T_a timer has elapsed if CNG was not detected or local operator has not taken control of the call.



NOTE 1 – At 1.8 to 2.5 seconds after the called station is connected to line, it sends a recorded announcement. CNG detection during this silent period.

NOTE 2 – $3.5 (\text{CNG}) \times 1.15 (\text{tolerance}) \times 2 \leq T_a < T_1 - (\text{OGM1}) - (\text{OGM3})$. $T_1 = 35 \pm 5$ seconds.

Figure D.1/T.30 – Terminal selection method for combined facsimile and telephone answering

Device 2: Combined facsimile and telephone answering and recording device

Full details of this procedure are defined in Figure D.2.

This procedure is similar to that described for device 1. The procedure differs in that it shall provide for speech detection during the CNG detection period to permit switching to the recording device.

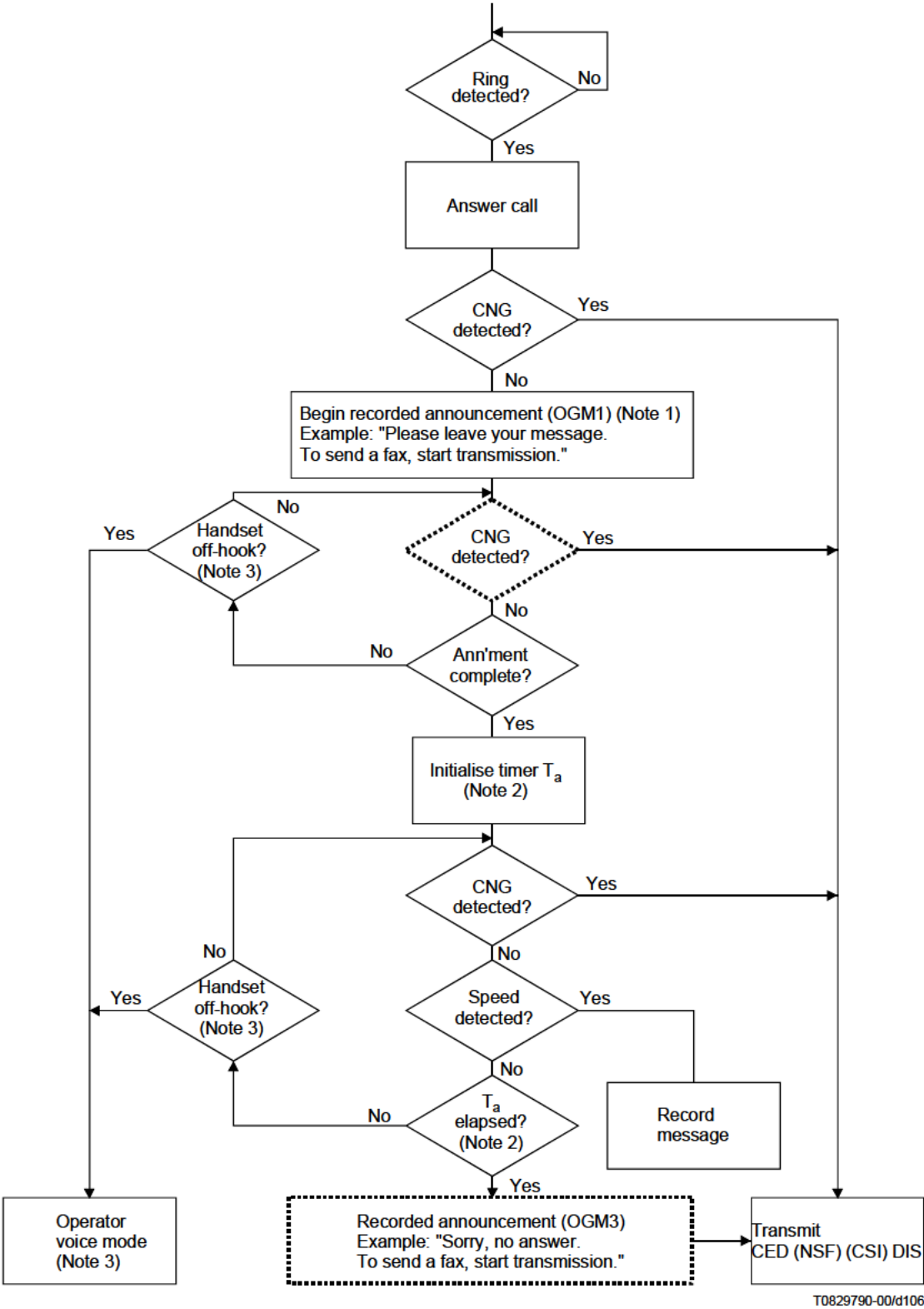


Figure D.2/T.30 – Terminal selection method for combined facsimile, telephone answering and recording device

Annex E

Procedure for the Group 3 document facsimile transmission of continuous-tone colour images

E.1 Introduction

This annex describes the additions to ITU-T Rec. T.30 to enable the transmission of continuous-tone (multilevel) colour and gray-scale images for Group 3 facsimile mode of operation.

The objective is to enable the efficient transmission of high quality, full colour and gray-scale images over the general switched telephone network and other networks. The images are normally obtained by scanning the original sources with scanners of 200 pels/25.4 mm or higher, and bit depths of eight bits per picture element per colour component or higher. The original sources are typically colour or gray-scale photographs or hard copies from high-quality printing systems.

The method specified here performs well on full-colour images, but for transmission of multi-colour images such as business graphics, other methods may be more efficient. Two such methods would be the transmission of images using ITU-T Recs T.434 (Binary File Transfer) and T.82 (JBIG encoding). This annex does not address the encoding of multi-colour images. This topic is left for further study.

The encoding methodology for continuous-tone (multilevel) images is based on the JPEG (ITU-T Rec. T.81 | ISO/IEC 10918-1) image encoding standard. The JPEG image coding method includes both a lossy mode and a lossless mode of encoding. This annex adopts the lossy mode of encoding which is based on the Discrete Cosine Transform.

The representation of colour image data is based on ITU-T Rec. T.42. It adopts a device-independent colour space representation, the CIELAB space, that allows unambiguous exchange of colour information.

This annex explains the procedure for negotiation of the capabilities for transmission of continuous-tone colour and gray-scale images. It specifies the definitions and the specifications of new entries to the Facsimile Information Field of the DIS/DTC and DCS frames of this Recommendation.

Information is specified pertaining to image digitization resolution (in bits/pel), spatial resolution, sampling ratio of colour components, JPEG capability, colour capability, and image data scaling that is subject to negotiation in the pre-message phase of the T.30 protocol.

This annex does not address the semantics and syntax of the actual encoding of the continuous-tone colour and gray-scale images. That information is included in Annex E/T.4.

The use of Error Correction Mode (ECM) for error-free transmission is mandatory in the procedure described by this annex. Under the error correction mode of transmission, the JPEG encoded image data are embedded in the Facsimile Coded Data (FCD) part of the HDLC (High-level Data Link Control) transmission frames specified by Annex A.

The technical features of encoding and decoding the continuous-tone colour and gray-scale image data are described in Annex E/T.4. It describes two modes of image encoding (lossy gray-scale and lossy colour) which are defined using ITU-T Rec. T.81.

E.2 Definitions

E.2.1 CIELAB: CIE 1976 (L^* a^* b^*) space: A colour space defined by the CIE (*Commission internationale de l'éclairage*), having approximately equal visually perceptible difference between equally spaced points throughout the space. The three components are L^* , or Lightness, and a^* and b^* in chrominance.

E.2.2 JPEG: Joint Photographic Experts Group, and also shorthand for the encoding method, described in ITU-T Rec. T.81, which was defined by this group.

E.2.3 baseline JPEG: A particular eight-bit sequential Discrete Cosine Transform (DCT) – based encoding and decoding process specified in ITU-T Rec. T.81.

E.2.4 quantization table: A set of 64 values used to quantize the DCT coefficients in baseline JPEG.

E.2.5 Huffman table: A set of variable length codes required in a Huffman encoder and a Huffman decoder.

E.3 Normative references

- ITU-T Recommendation T.4 (2003), *Standardization of Group 3 facsimile terminals for document transmission*.
- ITU-T Recommendation T.42 (2003), *Continuous-tone colour representation method for facsimile*.
- ITU-T Recommendation T.81 (1992) | ISO/IEC 10918-1:1994, *Information technology – Digital compression and coding of continuous-tone still images – Requirements and guidelines*. (Commonly referred to as JPEG standard.)

E.4 Negotiation procedure

The negotiation to transmit and receive JPEG encoded continuous-tone colour and gray-scale images under the Group 3 facsimile protocol is invoked through the setting of the bits in the DIS/DTC and DCS frames during the pre-message procedure (Phase B) of the T.30 protocol.

The first capability to be established between the calling terminal and the called terminal is to indicate whether JPEG Mode is available. Then the second capability to be established is whether full colour mode is available.

Thirdly, a means is provided to indicate to the called terminal that the Huffman tables are the default tables. The transmission of Huffman tables is mandatory.

In addition to these three characteristics, the following four capabilities (see Table E.1) that pertain to mandatory or optional capabilities are exchanged.

Table E.1/T.30 – Mandatory and optional capabilities

Mandatory	Optional
8 bits/pel/component	12 bits/pel/component
4:1:1 Chrominance subsampling	No subsampling (1:1:1)
CIE Standard Illuminant D50	Custom illuminant
Default gamut range	Custom gamut range
200 × 200 pels/25.4 mm	300 × 300 or 400 × 400 or 600 × 600 or 1200 × 1200 pels/25.4 mm
200 × 200 pels/25.4 mm	100 × 100 pels/25.4 mm

Annex F

Procedures for Group 3 facsimile transmission using the half-duplex modulation system defined in ITU-T Rec. V.34

F.1 Introduction

This annex describes the procedures to be used for the optional use of the half-duplex modulation system defined in ITU-T Rec. V.34 in Group 3 facsimile terminals covered by Annex A/T.4 and Annex A.

F.2 References

- ITU-T Recommendation V.8 (2000), *Procedures for starting sessions of data transmission over the general switched telephone network*.
- ITU-T Recommendation V.34 (1998), *A modem operating at data signalling rates of up to 33 600 bit/s for use on the general switched telephone network and on leased point-to-point 2-wire telephone-type circuits*.

F.3 Procedures

The use of the Error Correction Mode (ECM) is mandatory for all facsimile messages using the V.34 modulation system. The procedure described in Annex A shall be followed except as indicated below.

F.3.1 General

F.3.1.1 The terminal shall follow the start-up procedures defined in ITU-T Rec. V.8 and clause 12/V.34 except as noted in clause 6 and in this annex.

F.3.1.2 After receiving the ANSam answer tone, in order to keep network echo suppressors disabled, the source terminal must transmit continuously except for the silent periods defined in ITU-T Recs V.8 and V.34 during the start-up procedure and between control channel and primary channel transmissions. After control channel start-up, the recipient terminal shall be silent only when receiving primary channel training or data.

F.3.1.3 The binary coded procedural data shall be transmitted using the control channel also described in ITU-T Rec. V.34. The message data and RCP command shall be transmitted using the half-duplex primary channel described in ITU-T Rec. V.34.

F.3.1.4 After executing the control channel start-up procedure defined in 12.4/V.34, each terminal shall condition its receiver to receive HDLC frames and shall transmit HDLC flags using the control channel data rate determined between terminals during the control channel start-up procedure. At least two flags shall be sent prior to the first control channel frame after any start-up, resynchronization or retraining procedure.

The data signalling rate for the control channel shall be determined by the MPh sequence described in 12.4/V.34.

NOTE – Use of the asymmetric data signalling rate as defined in bit 50 of MPh in Table 23/V.34 is left for further study.

F.3.1.5 If, during control channel operation, a terminal determines, by some means, that its modulation system receiver has lost control channel synchronization with the remote transmitter, then it shall initiate a control channel retrain as described in 12.8/V.34.

F.3.2 Pre-message procedures (Phase B)

F.3.2.1 The TCF signal is not used in V.34 facsimile operation. Therefore, after transmitting a DCS frame, the source terminal shall transmit control channel HDLC flags while waiting to receive a valid response. The recipient terminal shall respond to a DCS with a CFR indicating that the entire pre-message procedure has been completed and the message transmissions may commence. The FTT response shall not be used.

F.3.2.2 After sending a CFR frame, the recipient modulation system shall send flags until a string of at least 40 consecutive 1s is detected and then shall transmit silence. While silent, the recipient terminal shall be prepared to receive the primary channel resynchronization signal followed by message data at the data rate determined by the MPh exchange.

F.3.2.3 After receiving a CFR frame, the source terminal shall transmit consecutive 1s until silence (or absence of flags) is detected from the recipient terminal and at least 40 1s have been sent. The source terminal shall then transmit silence for 70 ± 5 ms followed by the primary channel resynchronization signal as defined in ITU-T Rec. V.34 followed by the synchronization signal defined in A.3.1/T.4 and then the message data at the data rate determined by the MPh exchange.

NOTE 1 – Optionally, machines may restart the T1 timer when the V.8 procedure is completed in order to conform with operation of Annex D.

NOTE 2 – T2 timer shall be reset at the start of each new frame instead of the detection of flags.

F.3.3 In-message procedure and message transmission (Phase C)

Use of primary channel retrain as described in 12.7/V.34 is for further study.

F.3.4 Post-message procedure (Phase D)

F.3.4.1 After sending the message data and the return to control for partial page (RCP) sequence, the source terminal shall follow the primary channel turn-off procedure defined in ITU-T Rec. V.34 and then initiate either the control channel resynchronization procedure or, if a data rate change is desired, the control channel start-up procedure defined in ITU-T Rec. V.34. Its receiver shall be conditioned to detect either a control channel resynchronization response or a control channel start-up response in the case of the resynchronization procedure and a control channel start-up response in the case of the start-up procedure from the recipient terminal. The control channel start-up procedure allows the renegotiation of data rate through an MPh exchange

F.3.4.2 After receiving the message and the RCP sequence, the recipient modulation system shall condition its receiver to detect the control channel resynchronization signal. After detecting the signal, the recipient terminal shall respond with either the control channel resynchronization response or, if a data rate change is desired, the control channel start-up response in case of the resynchronization signal and with the control channel start-up response in case of the start-up signal. The control channel start-up procedure allows for the renegotiation of data rate through an MPh exchange.

F.3.4.3 After the control channel has been re-established, the source modulation system shall send the post-message command. After receiving the post-message command, the recipient terminal shall send the post-message response.

F.3.4.4 After sending the last post-message response between messages, the recipient modem modulation system shall send flags until a string of at least 40 consecutive 1s is detected and then shall transmit silence. While silent, the recipient terminal shall be prepared to receive the primary channel resynchronization signal followed by message data at the rate determined by the MPh exchange.

F.3.4.5 After receiving the last post-message response between messages, the source terminal shall transmit consecutive 1s until silence (or absence of flags) is detected from the recipient terminal and at least forty 1s have been sent. The source terminal shall then transmit silence for 70 ± 5 ms

followed by the primary channel resynchronization signal as defined in ITU-T Rec. V.34, followed by the synchronization signal defined in A.3.1/T.4 and then message data at the data rate determined by the MPh exchange.

NOTE 1 – Data rate change is possible at every start of the control channel according to the procedures in F.3.4.1 and F.3.4.2. CTR/CTC frames shall not be used in V.34 ECM protocol and EOR/ERR or DCN signals are used to transit.

NOTE 2 – Optionally, terminals may disconnect the line immediately after sending DCN without sending consecutive 1s.

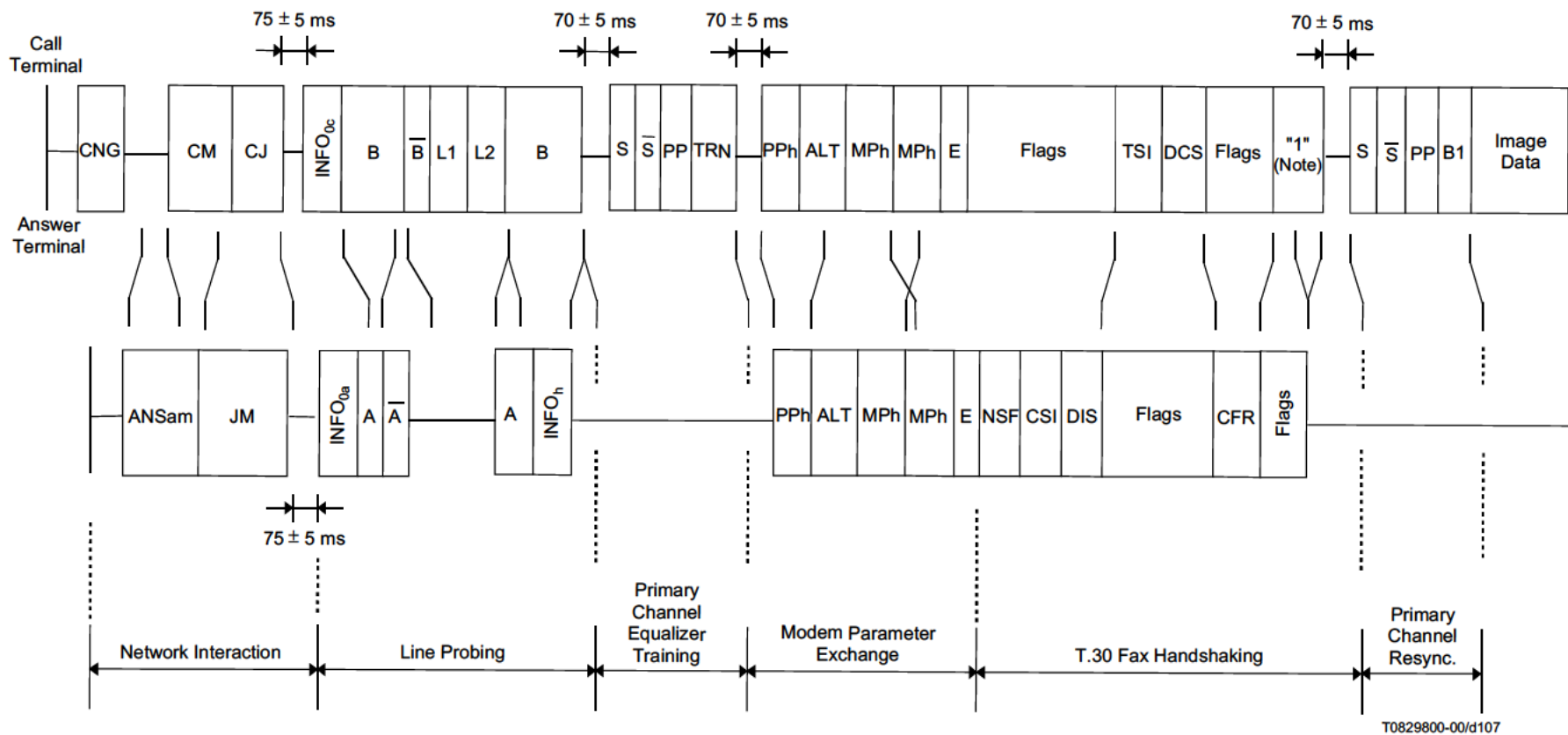
NOTE 3 – Use of PIP/PIN and PRI-Q commands is left for further study.

F.4 Half-duplex operating procedures of ITU-T Recs V.34 and V.8 for Group 3 facsimile

These procedures are defined by the corresponding parts of ITU-T Recs V.8 and V.34.

F.5 Examples of sequences

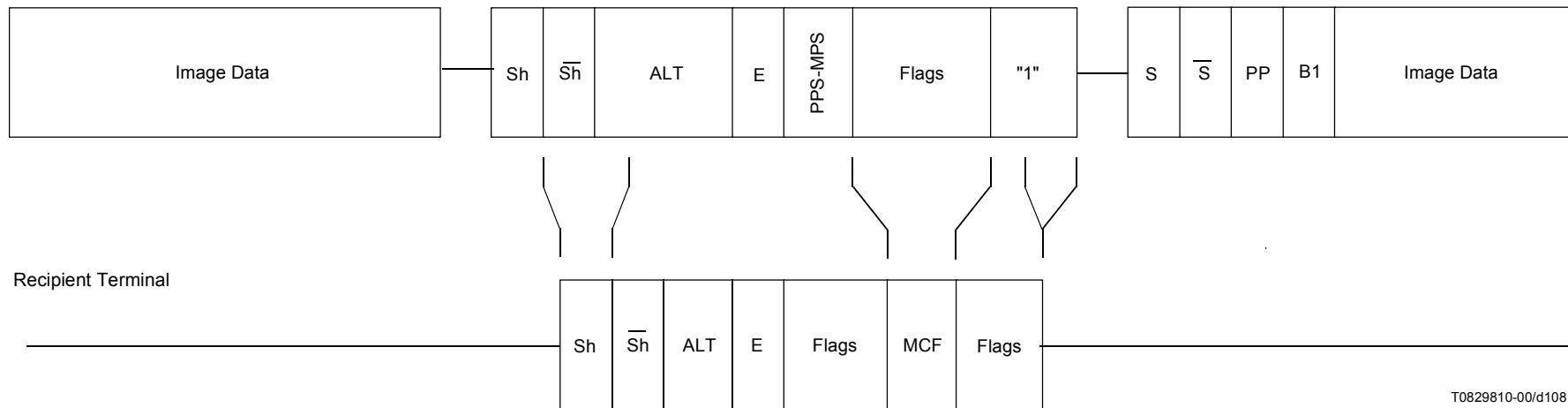
This clause contains examples of sequences used for the V.34 ECM protocol. See Figures F.5-1 to F.5-14.



NOTE – The string of consecutive 1s shall be followed by the 4T of scrambled ones defined in 12.6.3/V.34.

Figure F.5-1/T.30 – Typical V.34 fax start-up sequence

Source Terminal

**Figure F.5-2/T.30 – Between pages**

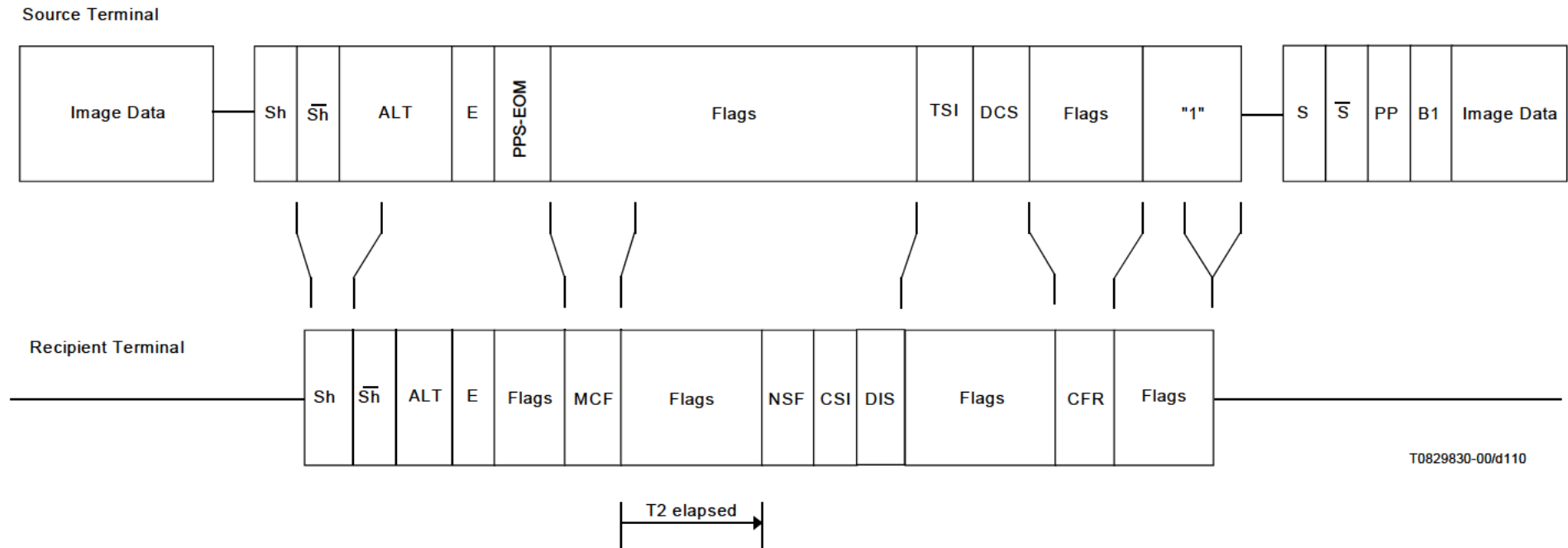
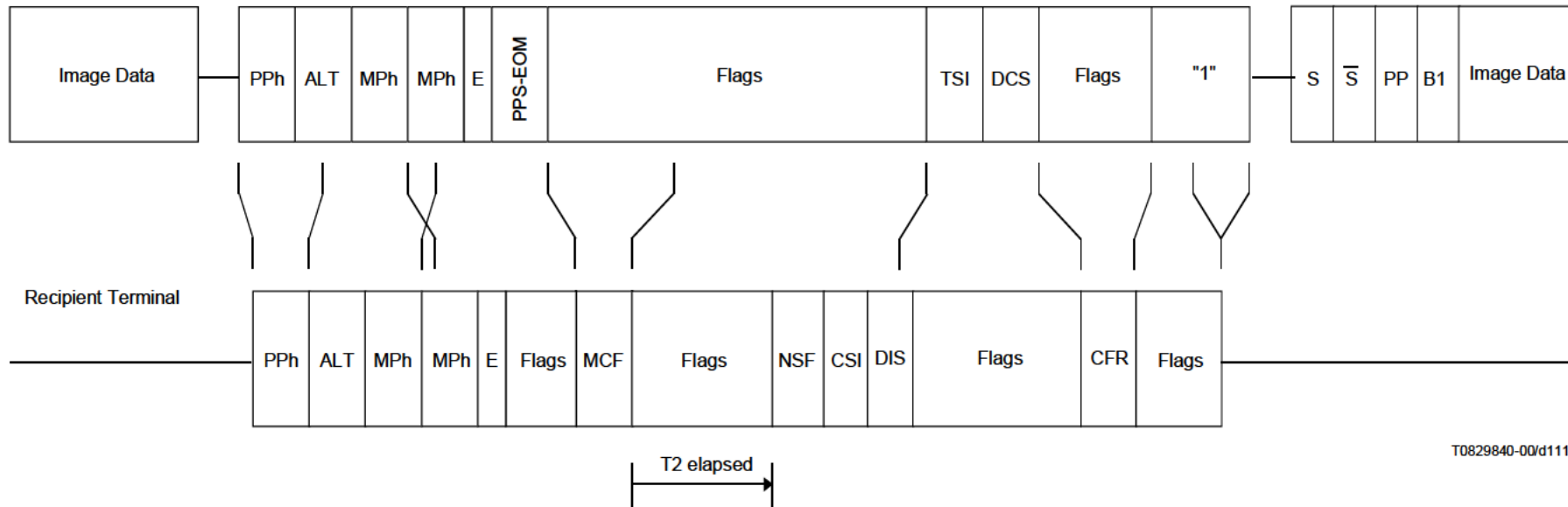


Figure F.5-4 – Mode change (without data rate change)

Source Terminal



T0829840-00/d111

Figure F.5-5/T.30 – Mode change (with data rate change from source terminal)

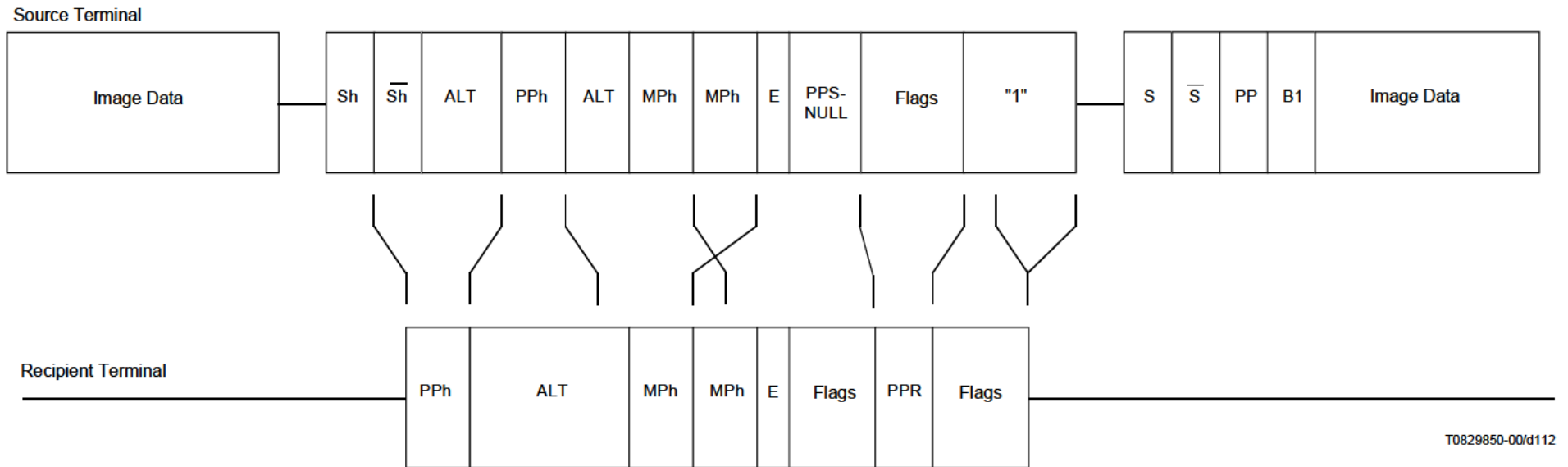
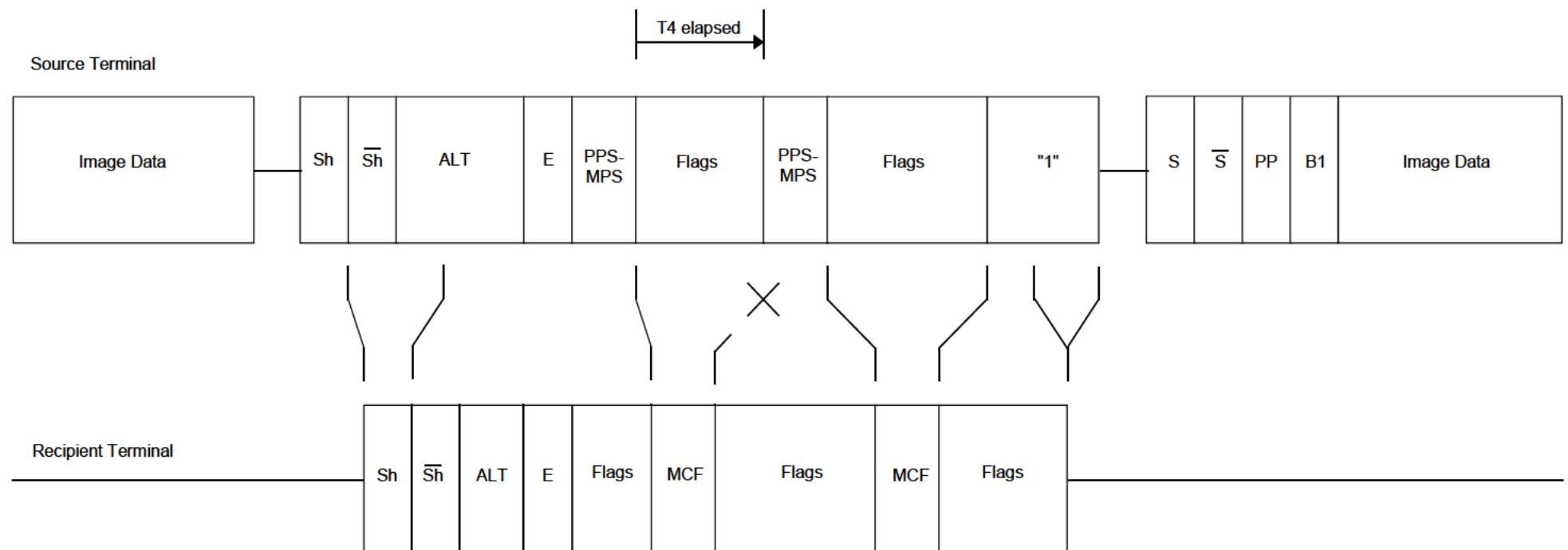
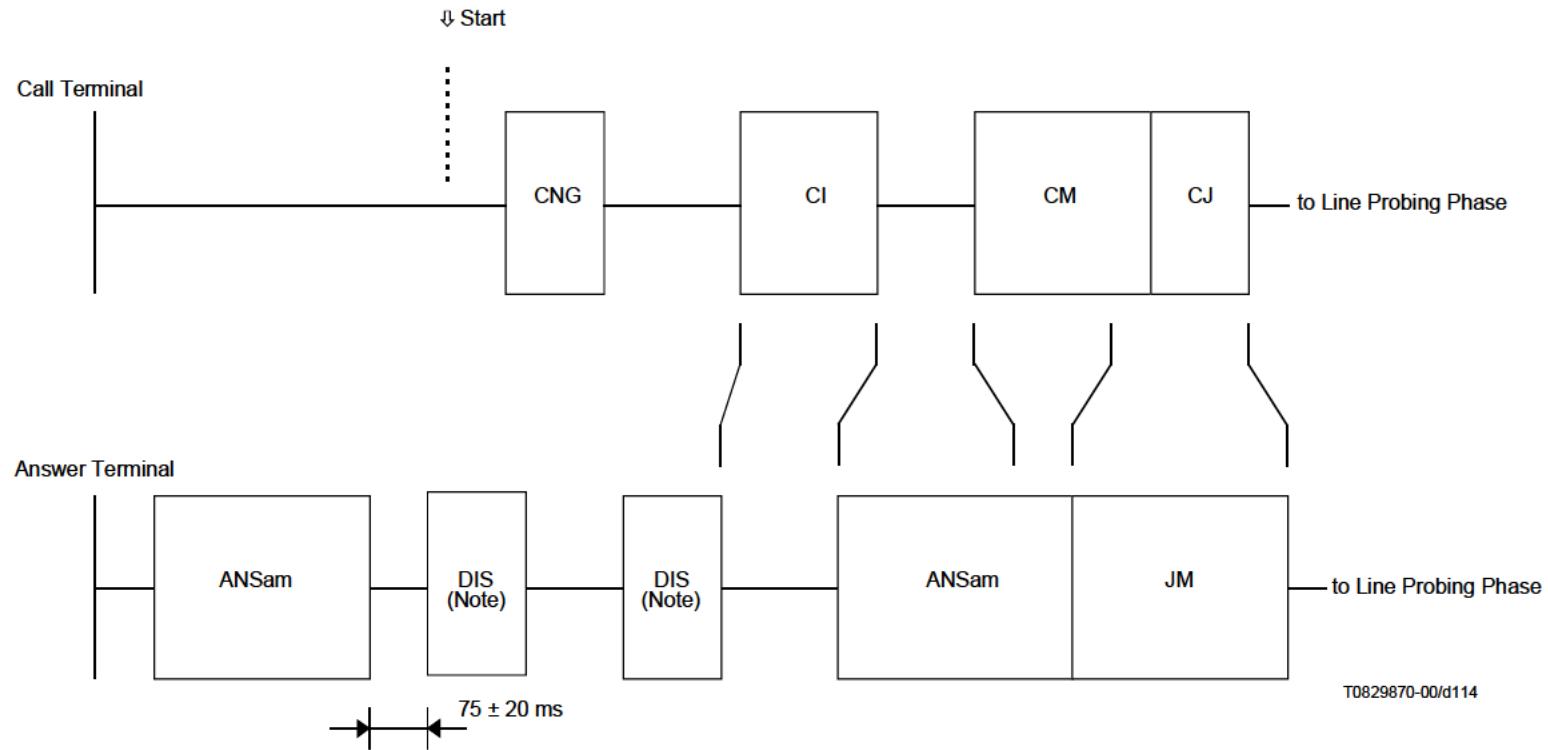


Figure F.5-6/T.30 – Data rate change between partial pages



T0829860-00/d113

Figure F.5-7/T.30 – Command retransmission



NOTE – Bit 6 is set to "1".

Figure F.5-8/T.30 – Manual sending

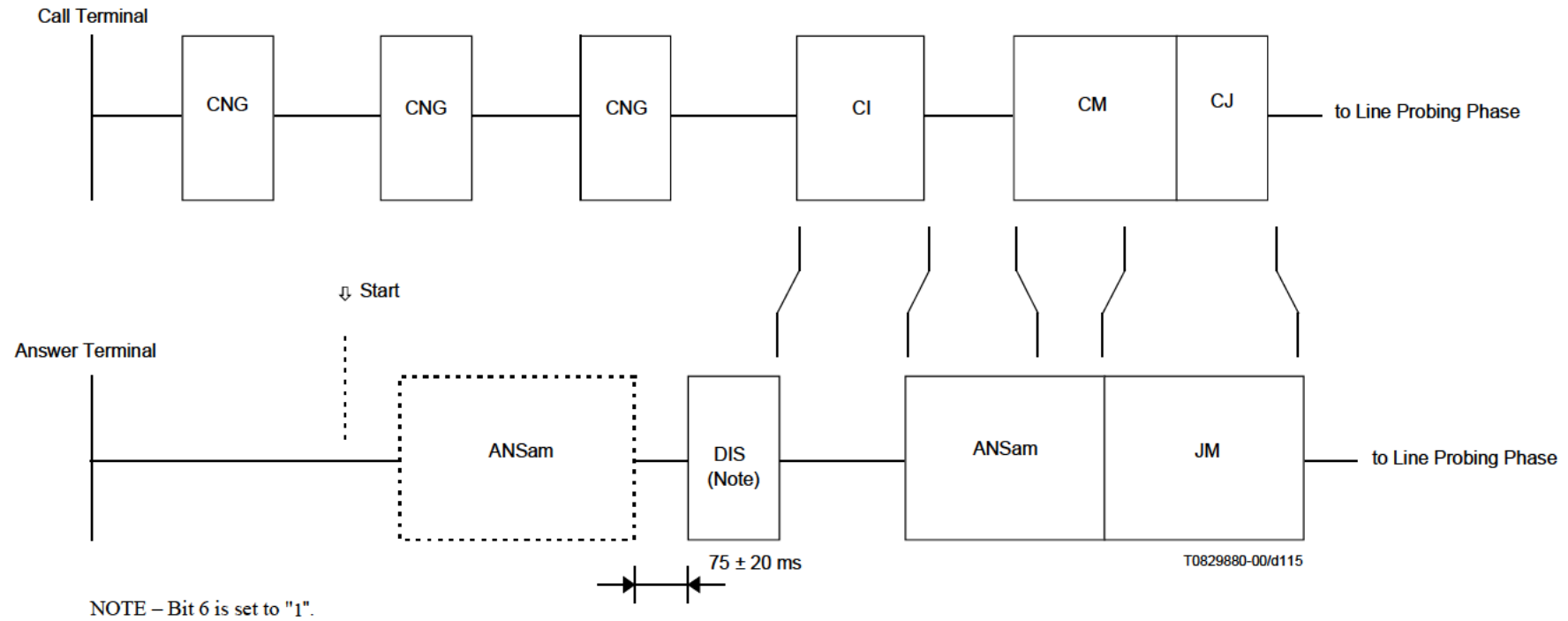
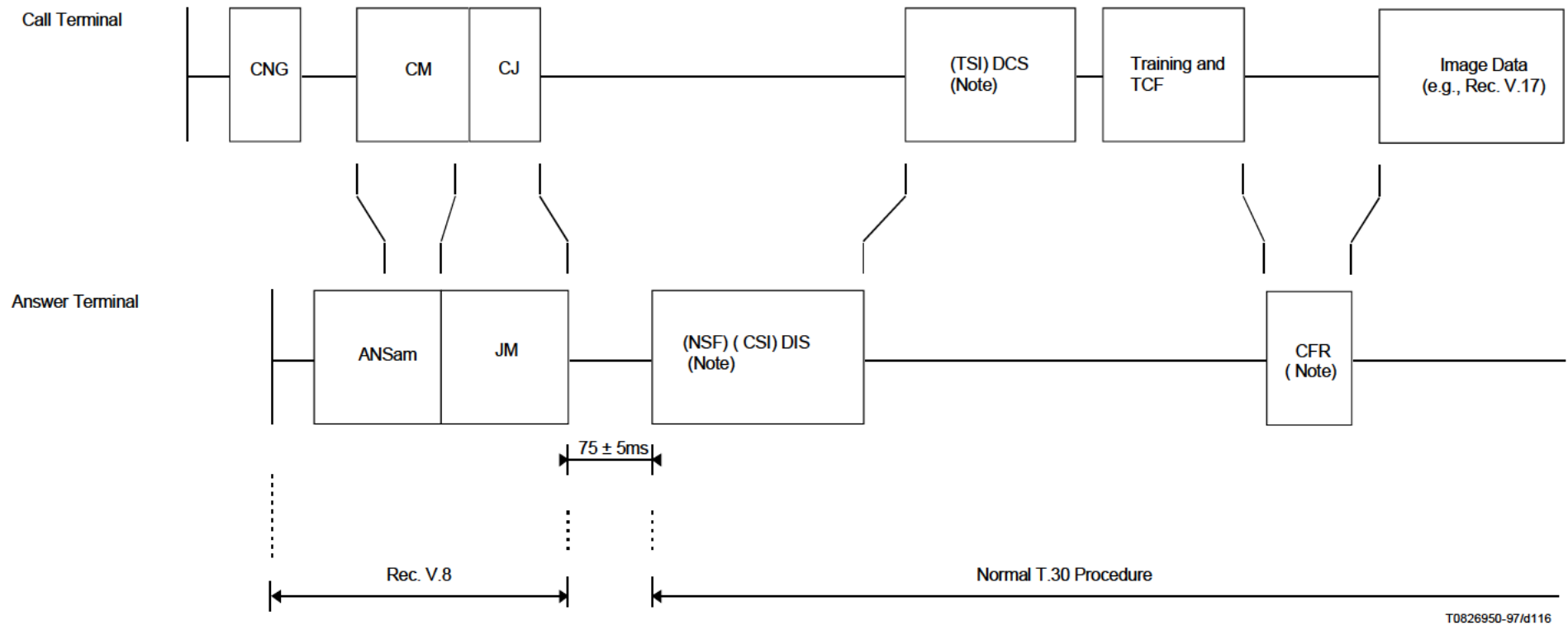


Figure F.5-9/T.30 – Manual receiving



NOTE – V.21 modulation mode

Figure F.5-10/T.30 – Normal T.30 procedure from ITU-T Rec. V.8

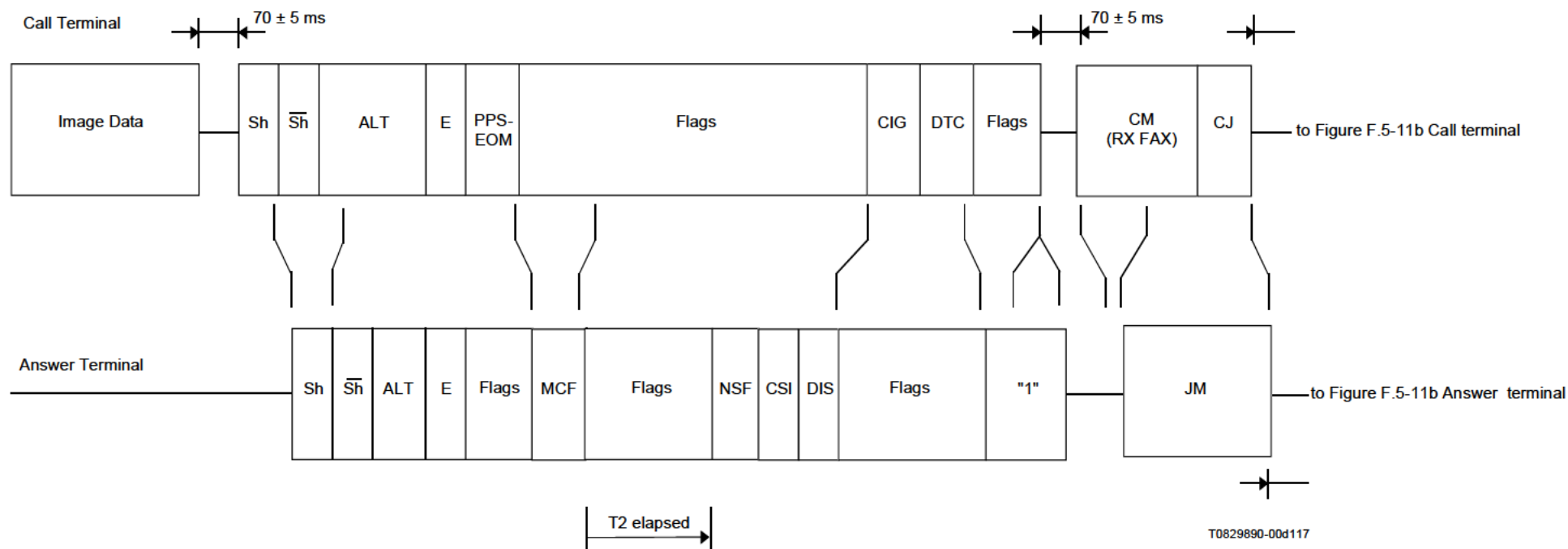


Figure F.5-11a/T.30 – Turnaround polling (send → receive in the call terminal [1/2])

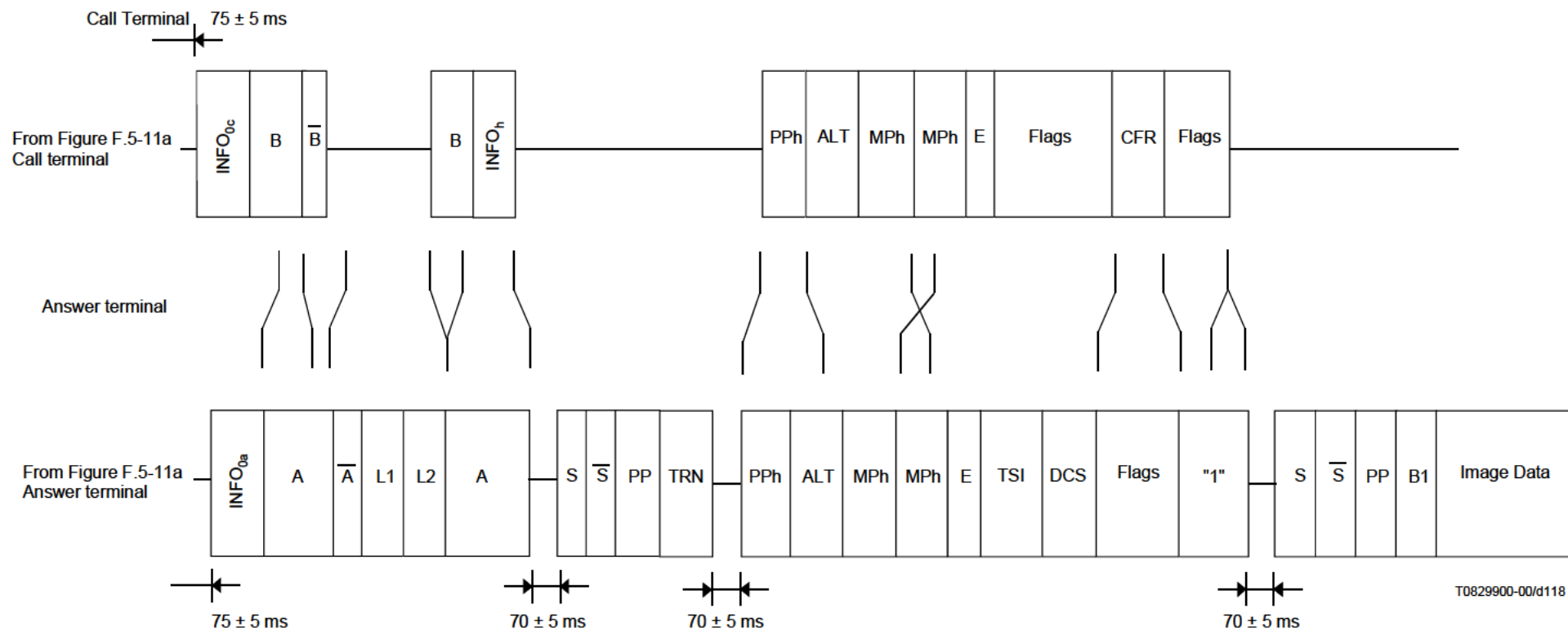


Figure F.5-11b/T.30 – Turnaround polling (send → receive in the call terminal [2/2])

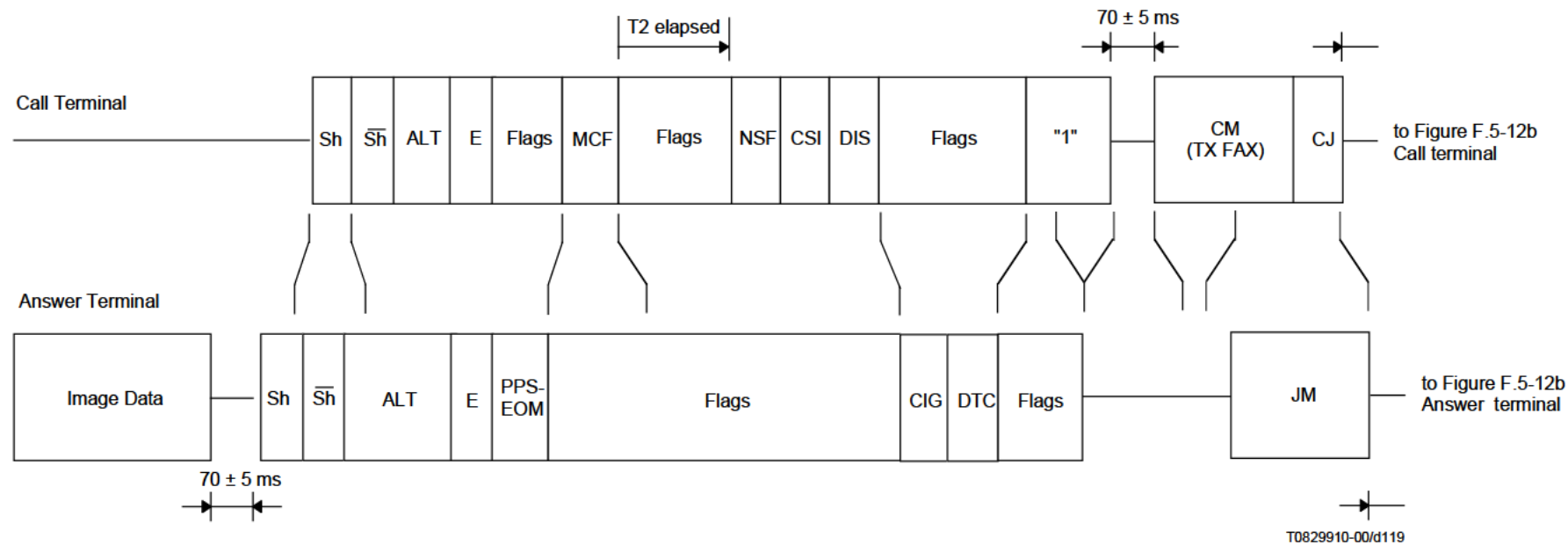


Figure F.5-12a/T.30 – Turnaround polling (receive → send in the call terminal [1/2])

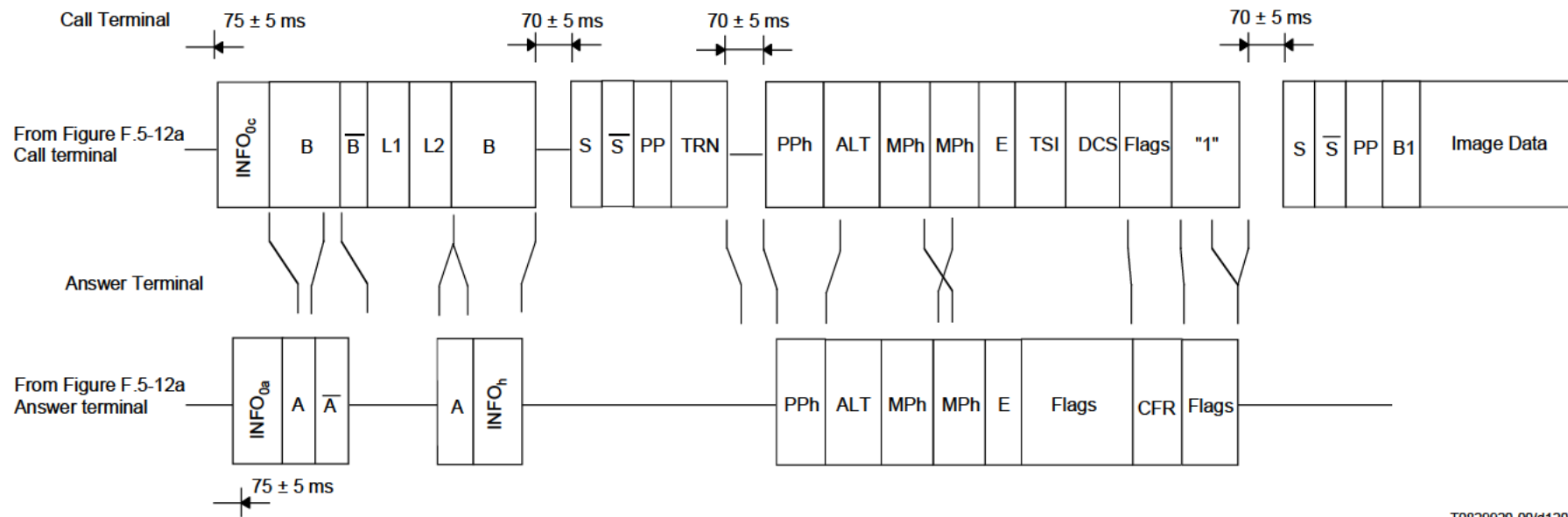
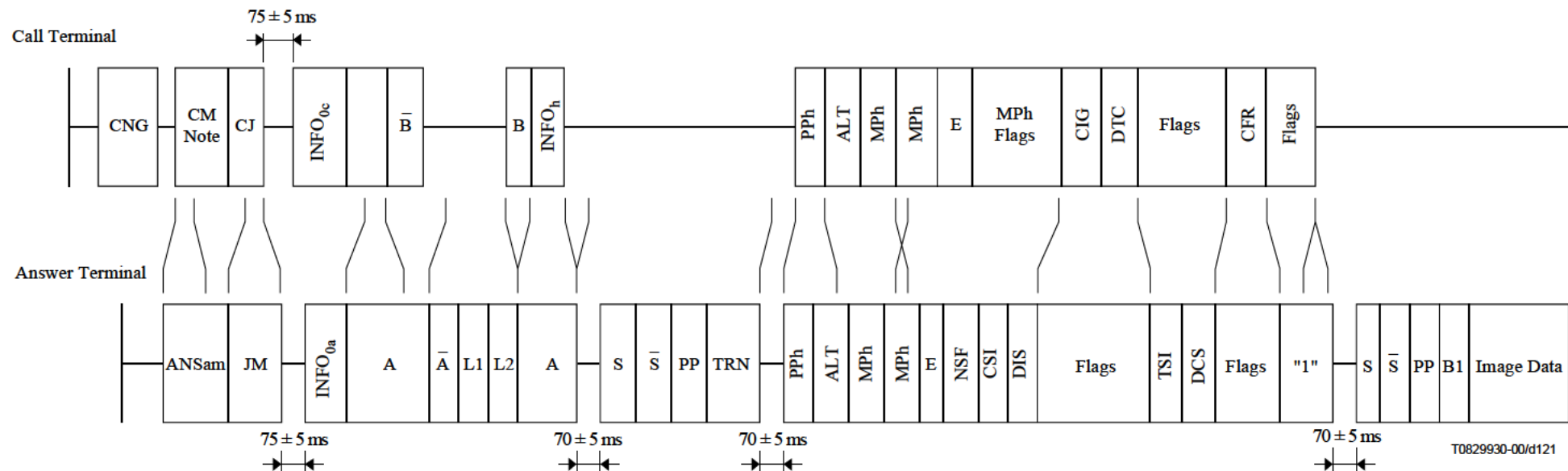


Figure F.5-12b/T.30 – Turnaround polling (receive → send in the call terminal [2/2])



NOTE – RX FAX is set.

Figure F.5-13/T.30 – Polling sequence

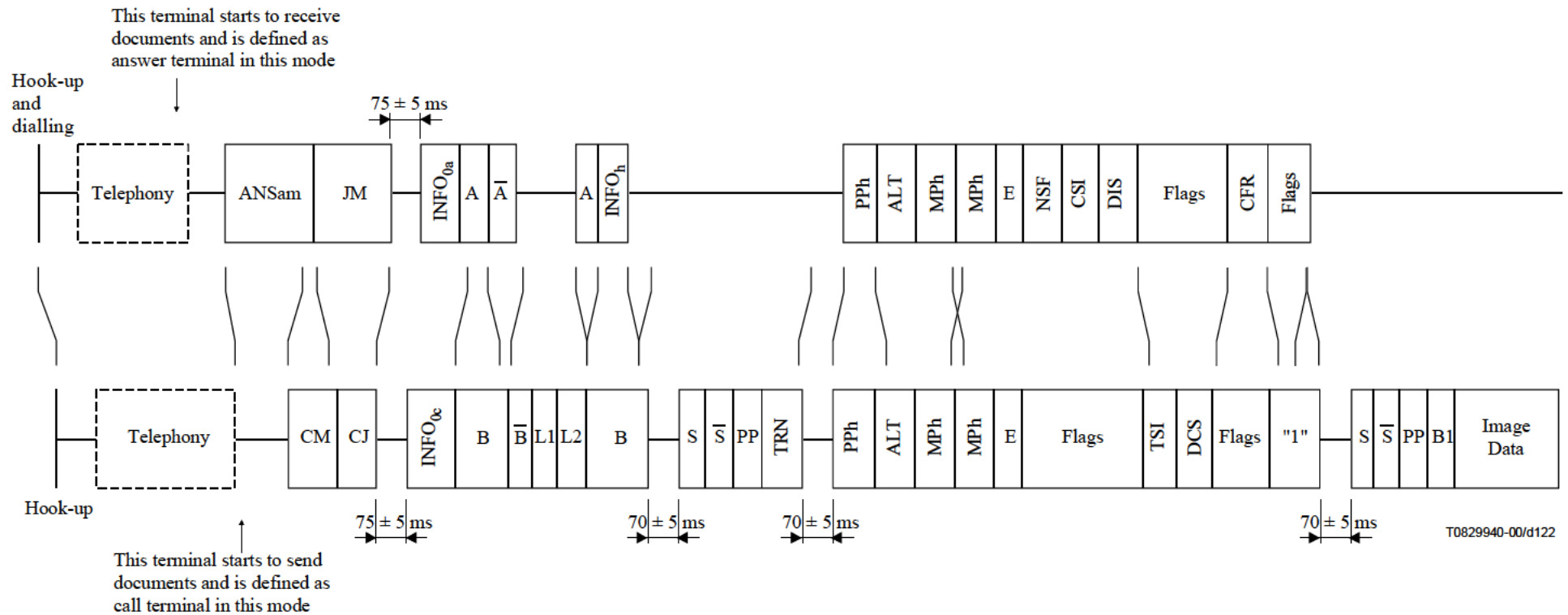


Figure F.5-14/T.30 – The manual communication after the telephony mode

Annex G

Procedures for secure Group 3 document facsimile transmission using the HKM and HFX system

G.1 Introduction

G.1.1 This annex describes the protocol used by Group 3 document facsimile terminals to provide secure communications using the HKM and HFX systems. The procedures used are based upon those defined in the main body as well as in Annexes A and C.

G.1.2 Use of this annex is optional.

G.1.3 The error correction defined in Annex A or Annex C (as appropriate) is mandatory.

G.2 Outline of the secure facsimile document procedure

G.2.1 The HKM and HFX systems provide the following capabilities for secure document communications between entities (terminals or terminal operators):

- mutual entity authentication;
- secret session key establishment;
- document confidentiality;
- confirmation of receipt;
- confirmation or denial of document integrity.

G.2.2 Functions

Key management is provided using the HKM system defined in Annex B/T.36. Two procedures are defined: the first being registration and the second being the secure transmission of a secret key. Registration establishes mutual secrets and enables all subsequent transmissions to be provided securely. In subsequent transmissions, the HKM system provides mutual authentication, a secret session key for document confidentiality and integrity, confirmation of receipt and a confirmation or denial of document integrity.

Document confidentiality is provided using the carrier cipher defined in Annex D/T.36. The carrier cipher uses a 12-decimal digit key which is approximately equivalent to 40 bits.

Document integrity is provided using the system defined in Annex E/T.36. ITU-T Rec. T.36 defines the hashing algorithm including the associated calculations and information exchange.

G.2.3 Method

In the registration mode, the two terminals exchange information which enables entities to uniquely identify each other. This is based upon the agreement between the users of a secret one-time key. Each entity stores a 16-digit number which is uniquely associated with the entity with which it has carried out registration.

When it is required to send a document securely, the transmitting terminal transmits the 16-digit secret number associated with the receiving entity together with a random number and an encrypted session key as a challenge to the receiving entity. The receiving terminal responds by transmitting the 16-digit key associated with the transmitting entity along with a random number and a re-encrypted version of the challenge from the transmitting entity. At the same time it transmits a

random number and an encrypted session key as a challenge to the transmitting entity. The transmitting terminal responds with a random number and a re-encrypted version of the challenge from the receiving entity. This procedure enables the two entities to mutually authenticate each other. At the same time, the transmitting terminal transmits a random number and the encrypted session key to be used for encrypting and hashing.

After transmission of the document, the transmitting terminal transmits a random number and an encrypted session key as a challenge to the receiving entity. At the same time, it sends a random number and encrypted hash value which enables the receiving entity to ensure the integrity of the received document. The receiving terminal transmits a random number and the re-encrypted version of the challenge from the transmitting entity. At the same time, it sends a random number and encrypted Integrity Document to act as confirmation or denial of the integrity of the received document.

The hashing algorithm used for document integrity is carried out on the whole document.

An override mode is provided, it does not involve the exchange of any security signals between the two terminals. The users agree a one-time secret session key to be entered manually. This is used by the transmitting terminal to encrypt the document and by the receiving terminal to decrypt the document.

G.3 References

- ITU-T Recommendation T.4 (2003), *Standardization of Group 3 facsimile terminals for document transmission*.
- ITU-T Recommendation T.36 (1997), *Security capabilities for use with Group 3 facsimile terminals*.

G.4 Definitions

G.4.1 Operation on the PSTN using the V.27 ter, V.29, V.17 and V.34 (half-duplex mode) modulation systems

The signals and definitions used with the secure facsimile document procedures are as defined in the main body and in Annex A together with those detailed in G.6.1.

G.4.2 Operation on the PSTN using the V.34 (full-duplex mode) modulation system and on the ISDN

The signals and definitions used with the secure facsimile document procedures are as defined in Annex C together with those in G.6.1.

G.5 Abbreviations

G.5.1 The abbreviations used for secure facsimile transmission are as defined in the main body of this Recommendation and in Annexes A and C together with those specified below.

ESHx	Encrypted Scrambled Hash Value from the transmitter
ESIMy	Encrypted Scrambled Integrity Message from the receiver
ESSC1x	Encrypted Scrambled Secret Challenge key from the transmitter
ESSC1y	Encrypted Scrambled Secret Challenge key from the receiver
ESSC2x	Encrypted Scrambled Secret Challenge key from the transmitter
ESSR1x	Encrypted Scrambled Secret Response key from the transmitter
ESSR1y	Encrypted Scrambled Secret Response key from the receiver
ESSR2y	Encrypted Scrambled Secret Response key from the receiver

ESSS1x	Encrypted Scrambled Secret session key from the transmitter
RCNx	Registered Crypt Number (16 decimal digits in 16 octets) associated with the transmitter
RCNy	Registered Crypt Number (16 decimal digits in 16 octets) associated with the receiver
RK	Receiver Keys – see G.6.1
RNC1x	Random number associated with a secret challenge from the transmitter
RNC1y	Random number associated with a secret challenge from the receiver
RNC2x	Random number associated with a secret challenge from the transmitter
RNIMy	Random number associated with an integrity message from the receiver
RNSR1x	Random number associated with a secret response from the transmitter
RNSR1y	Random number associated with a secret response from the receiver
RNSR2y	Random number associated with a secret response from the receiver
RNSS1x	Random number associated with a secret session key from the transmitter
RTC	Return To Control – as defined in ITU-T Rec. T.4
TK	Transmitter Keys – see G.6.1
TKx	Transfer Key provided by the transmitter
TKy	Transfer Key provided by the receiver
TNR	Transmitter Not Ready – see G.6.1
TR	Transmitter Ready – see G.6.1

NOTE 1 – All Random Number values are 4 decimal digits in 4 octets.

NOTE 2 – All Encrypted Scrambled values are 12 decimal digits in 12 octets.

G.6 Facsimile procedures

G.6.1 Facsimile control field

The HKM Key Management system uses the T.30 Transmitter Keys (TK) and Receiver Keys (RK) frames. The FIF contents of these signals vary according to use and are listed G.6.2. Each TK and RK signal is suffixed by a digit for cross reference to the flow diagrams and signal sequence diagrams in this annex.

Each key transferred (other than during Registration) is in Encrypted Scrambled (ES) format and is accompanied by an associated Random Number (RN).

- 1) *Transmitter Not Ready (TNR)* – This signal is used to indicate that the transmitter is not yet ready to transmit.
Format: X101 0111
- 2) *Transmitter Ready (TR)* – This signal is used to ask the status of the transmitter.
Format: X101 0110
- 3) *Transmitter Keys (TK)* – This signal is used to carry security keys, etc., from the document transmitter to the document receiver. The FIF contents of this signal are defined later in this annex and will vary according to the circumstances under which they are used.
Format: 1101 0010

- 4) *Receiver Keys (RK)* – This signal is used to carry security keys, etc., from the document receiver to the document transmitter. The FIF contents of this signal are defined later in this annex and will vary according to the circumstances under which they are used.

Format: 0101 0010

G.6.2 Facsimile information fields

The coding of the keys shall be as shown in Table 3 and the least significant bit of the least significant digit shall be the first bit transmitted.

G.6.2.1 Mutual Registration and authentication

See Table G.1.

Table G.1/T.30

Signal	FIF octets	FIF contents
TK0	1	0000 0000
	2 length	0010 0000
	3-18	TK _x
	19-22	RNC0 _x
	23-34	ESSC0 _x
RK1	1	0000 0001
	2 length	0100 0000
	3-18	RCN _y
	19-34	TK _y
	35-38	RNSR0 _y
	39-50	ESSR0 _y
	51-54	RNC0 _y
	55-66	ESSC0 _y
TK2	1	0000 0010
	2 length	0010 0000
	3-18	RCN _x
	19-22	RNSR0 _x
	23-34	ESSR0 _x

G.6.2.2 Pre-message signals: mutual authentication and exchange of secret session key

See Table G.2.

Table G.2/T.30

Signal	FIF octets	FIF contents
TK8	1	0000 1100
	2 length	0010 0000
	3-18	RCN _y
	19-22	RNC1 _x
	23-34	ESSC1 _x
RK9	1	0000 1001
	2 length	0011 0000
	3-18	RCN _x
	19-22	RNSR1 _y
	23-34	ESSR1 _y
	35-38	RNC1 _y
	39-50	ESSC1 _y
TK10	1	0000 1010
	2 length	0010 0000
	3-6	RNSR1 _x
	7-18	ESSR1 _x
	19-21	RNSS1 _x
	23-34	ESSS1 _x
NOTE – If the document is not encrypted, RNC1 _x and ESSS1 _x are set to all zeros.		

G.6.2.3 In-message procedure

From the transmitter to the receiver. The in-message procedure formats and specific signals shall be as defined in Annex A/T.4.

G.6.2.4 Post-message signals: document confirmation and integrity (normal transmission)

See Table G.3.

Table G.3/T.30

Signal	FIF octets	FIF contents
TK16	1	0001 0000
	2 length	0010 1000
	3-6	RNC2x
	7-18	ESSC2x
	19-42	ESHx
RK17	1	0001 0001
	2 length	0010 0000
	3-6	RNSR2y
	7-18	ESSR2y
	19-22	RNIMy
	23-34	ESIMy
NOTE 1 – If the document does not have an integrity check, ESHx, RNIMy and ESIMy are set to all zeros.		
NOTE 2 – Frame TK16 is not provided if DCS indicates no hashing.		
NOTE 3 – Frame RK17 is not provided if TK16 is not provided.		

G.6.2.5 General notes

- 1) During registration, challenges and responses are mandatory. The challenge/response mechanism is defined in ITU-T Rec. T.36.
- 2) During normal calls, all valid challenges and responses must have a non-zero random number. Random numbers set to zero in challenges or responses indicate that mutual authentication is not supported.
- 3) TK16/RK17 are normally sent with/after PPS-EOP except in the case of turnaround polling when they may be sent with/after PPS-EOM.
- 4) Hashing/encryption are determined by the first DIS/DCS exchange and apply to every document transmitted in that session.

G.7 Flow diagrams**G.7.1 Operation on the PSTN using the V.27 *ter*, V.29, V.17 and V.34 (half-duplex mode) modulation systems**

The flow diagrams in Figure G.7 show the phase B, pre-message procedures, phase C, message procedure, phase D, post-message procedure and phase E, call release, for both the transmitting and receiving terminals.

Reference should also be made to the procedures defined in ITU-T Rec. T.36.

G.7.2 Flow diagram rules

The flow diagrams follow two simple rules:

- 1) All lines have an arrow at the destination only.
- 2) No lines cross.

G.7.3 Timers used in the flow diagrams

T1	35 s \pm 5 s
T2	6 s \pm 1 s
T3	10 s \pm 5 s
T4	4.5 s \pm 15% for manual units 3.0 s \pm 15% for automatic units
T5	60 s \pm 5 s

G.7.4 Abbreviations and descriptions used in the flow diagrams

Unless defined otherwise below, the definition of the flow chart terms is as given in the main body and/or in Annex A.

Authen reqd? Check to see if mutual authentication is required at the beginning of the transmission.

NOTE 1 – Once mutual authentication has been completed, then within the same session the "No" exit should always be followed.

Reg mode? Check to see if security registration is required.

First page? Check to see if mutual authentication is required at the beginning of the transmission.

NOTE 2 – Once mutual authentication has been completed, then within the same session the "No" exit should always be followed.

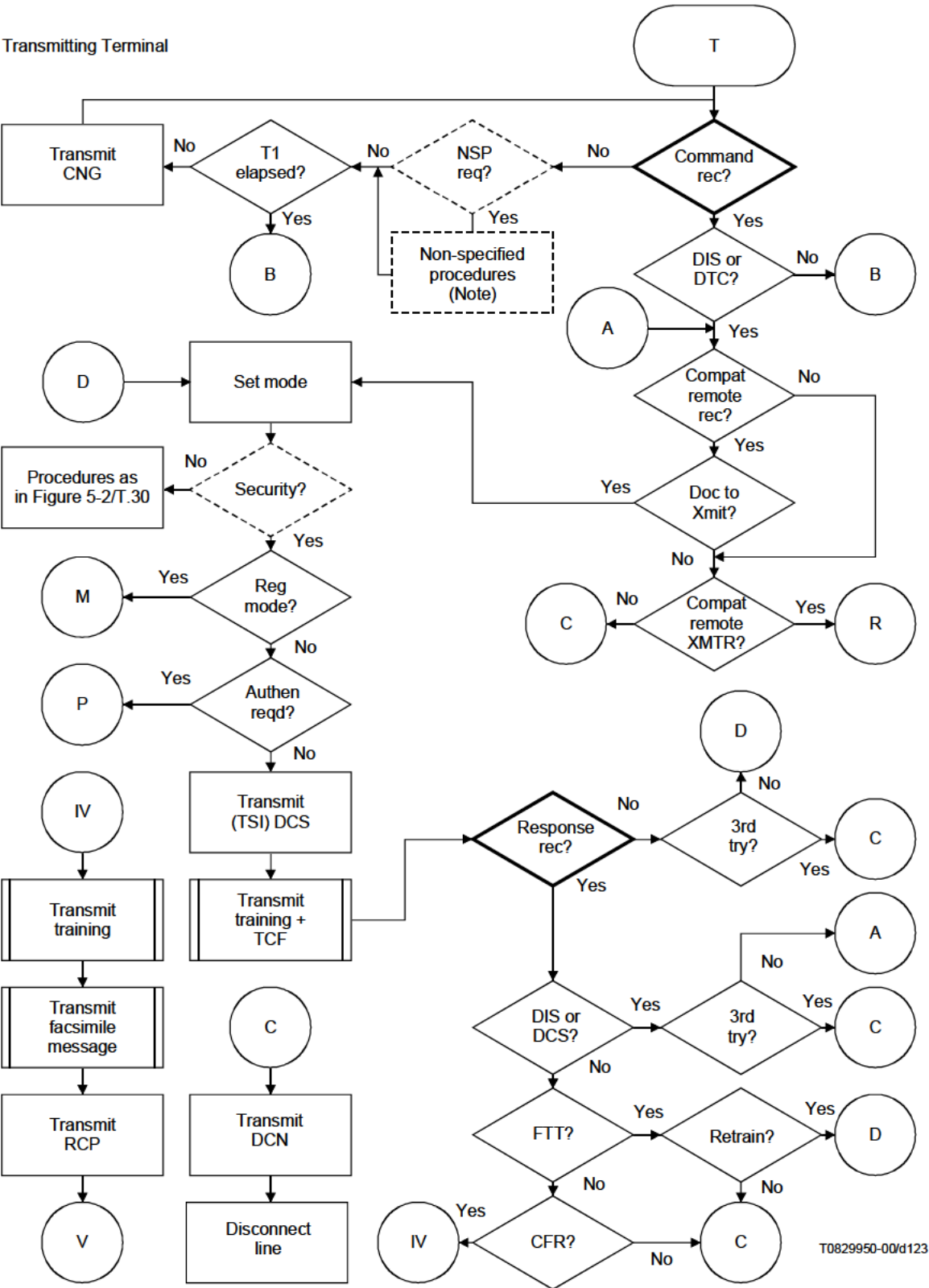
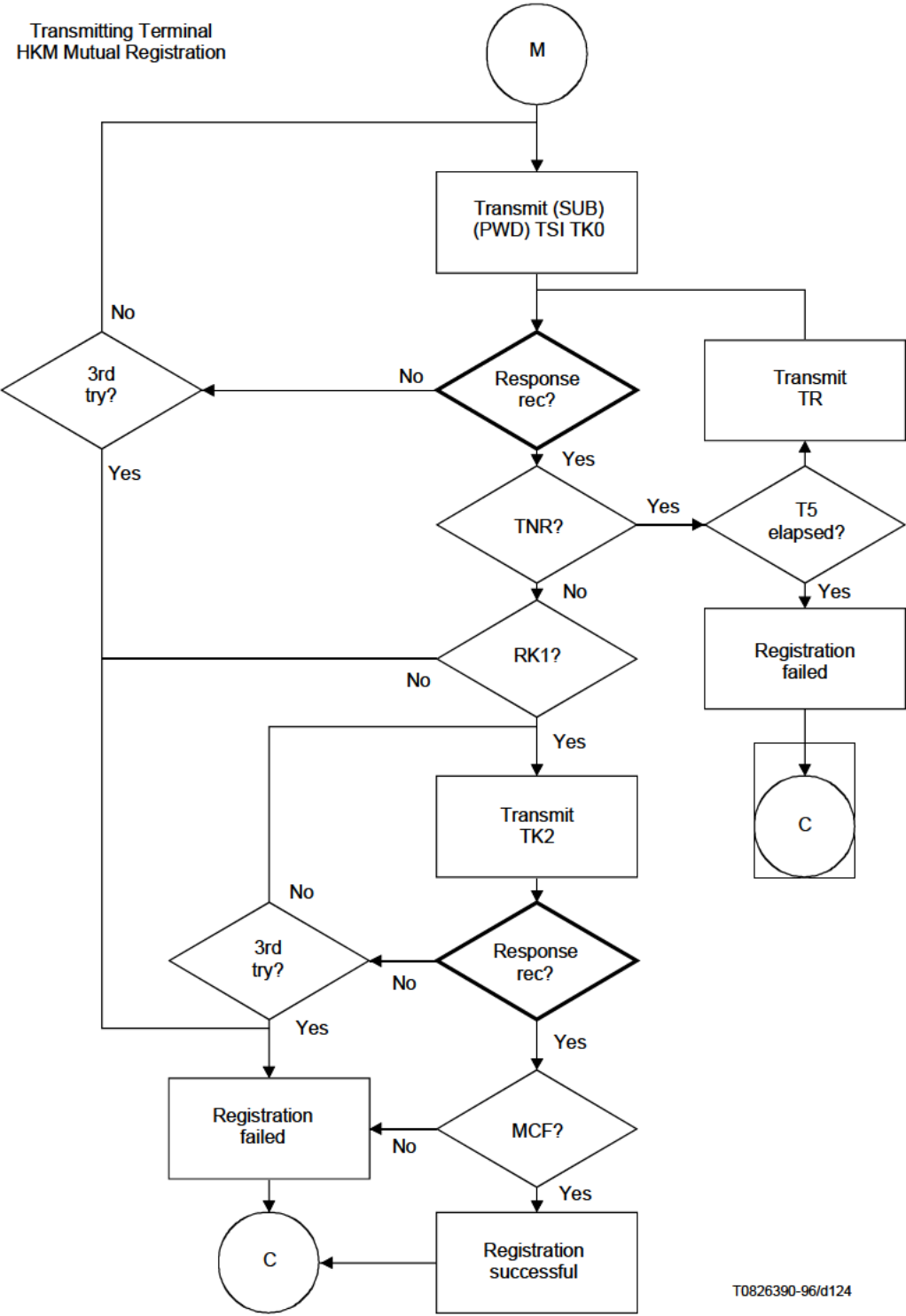


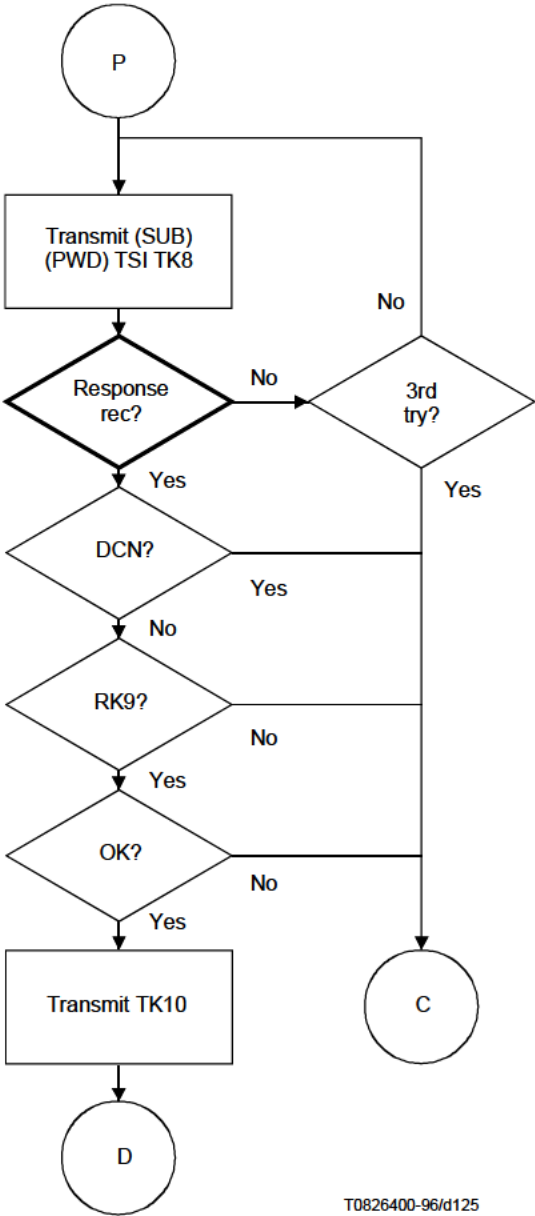
Figure G.7/T.30 (sheet 1 of 20)



T0826390-96/d124

Figure G.7/T.30 (sheet 2 of 20)

Transmitting Terminal



T0826400-96/d125

Figure G.7/T.30 (sheet 3 of 20)

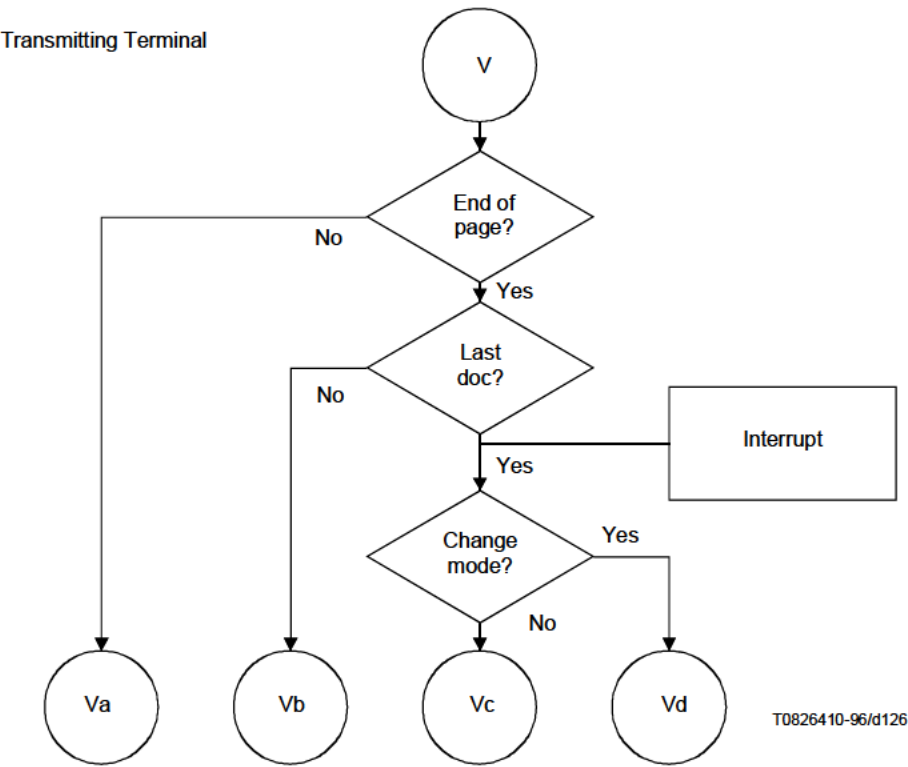


Figure G.7/T.30 (sheet 4 of 20)

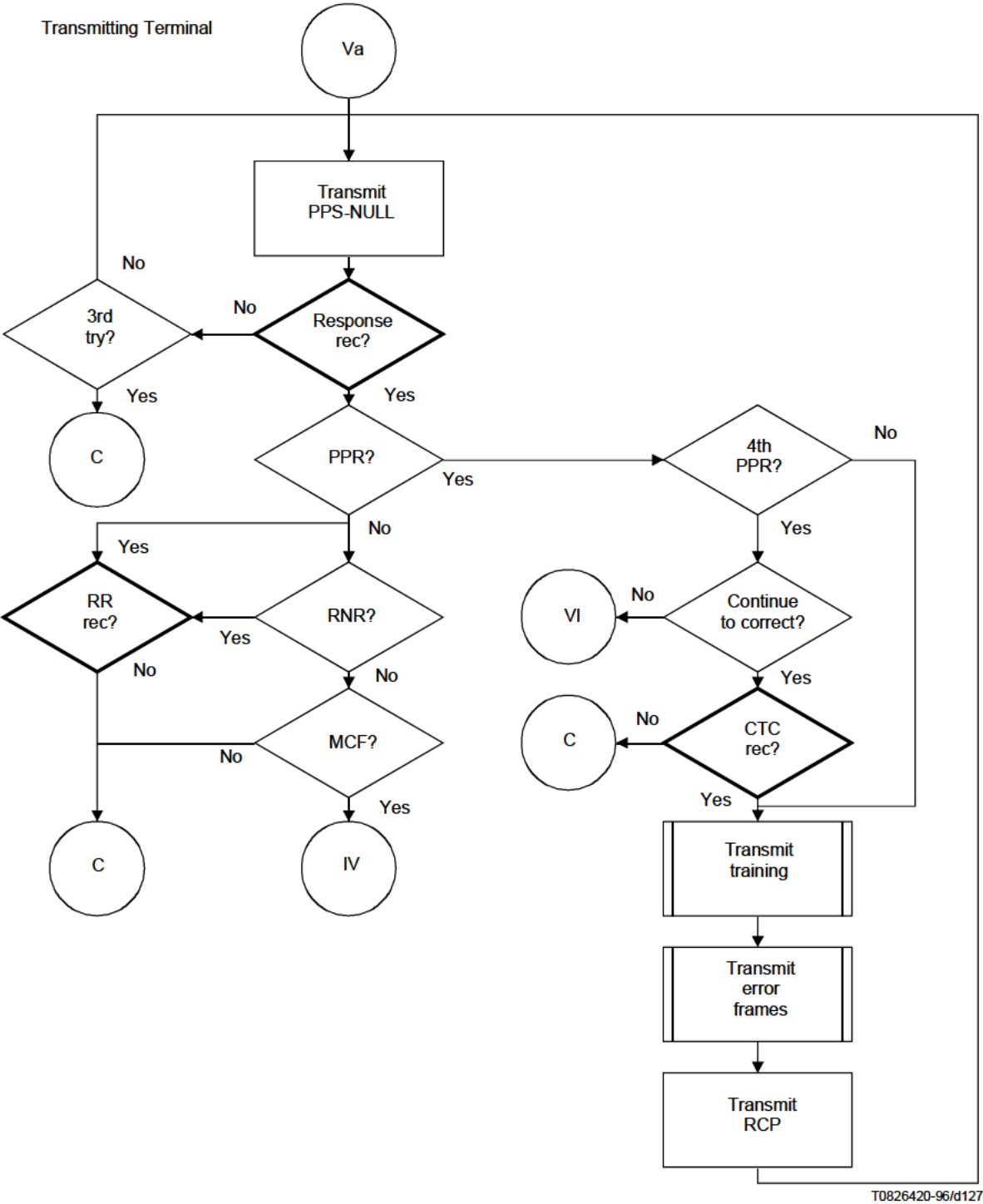


Figure G.7/T.30 (sheet 5 of 20)

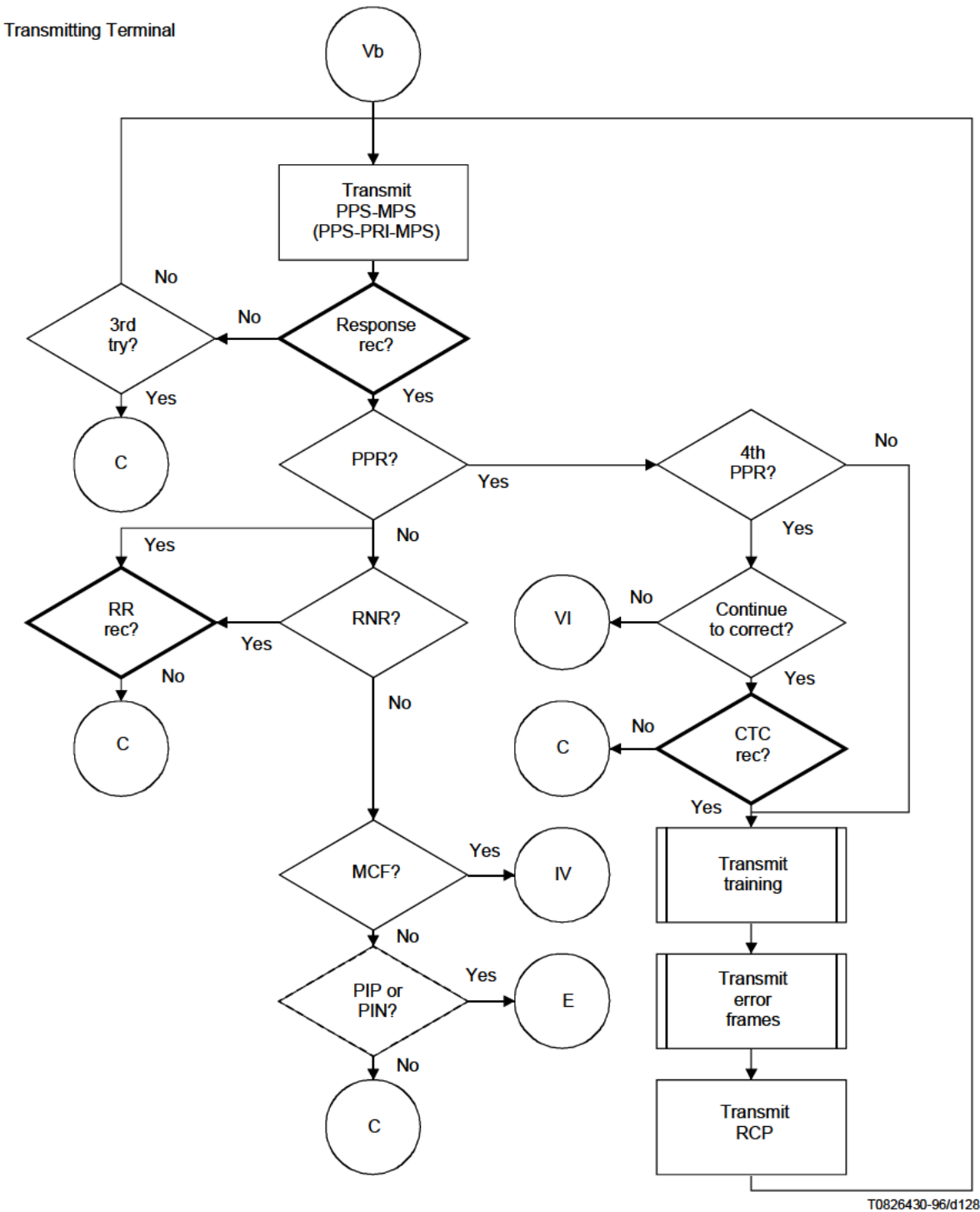


Figure G.7/T.30 (sheet 6 of 20)

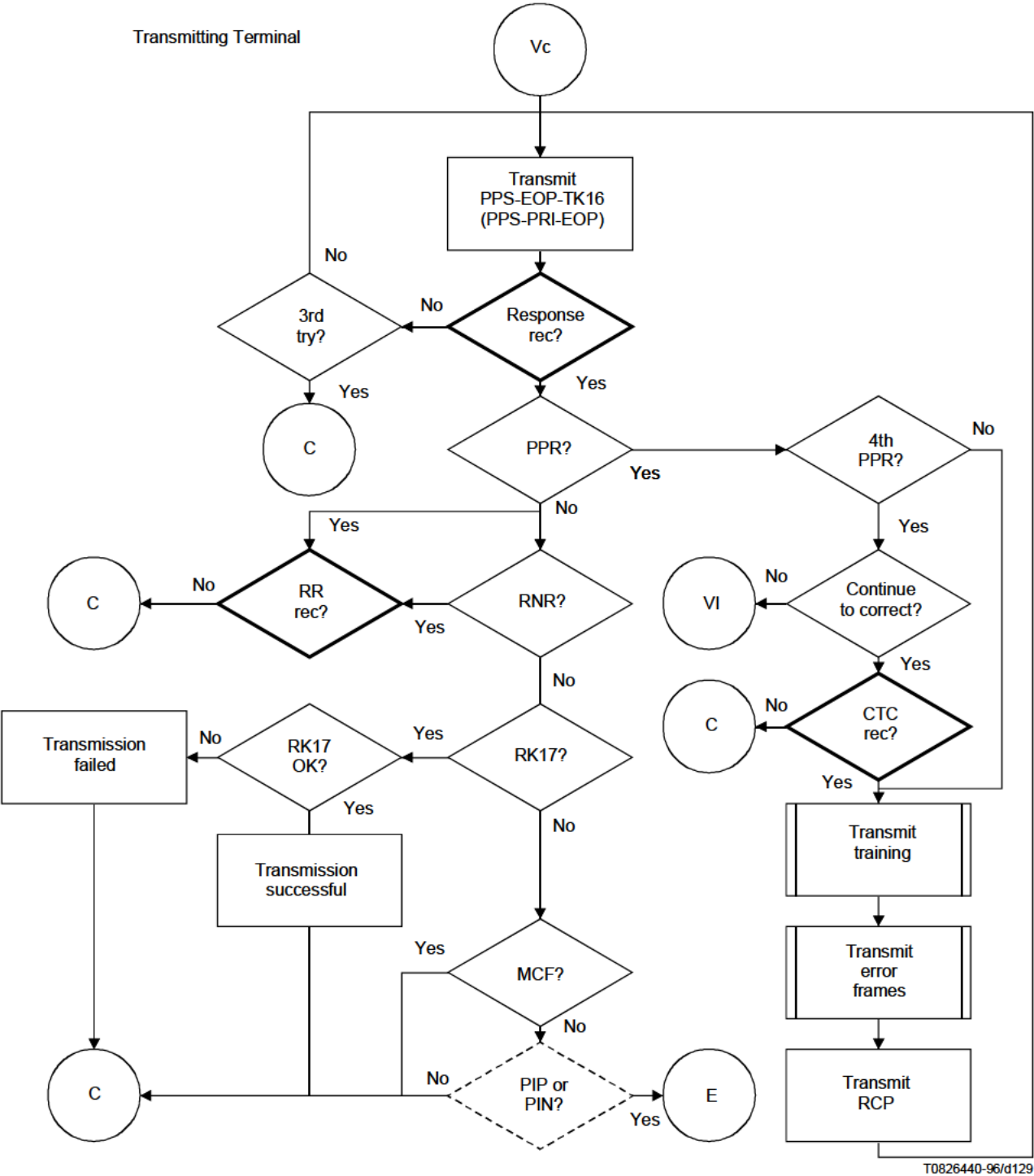


Figure G.7/T.30 (sheet 7 of 20)

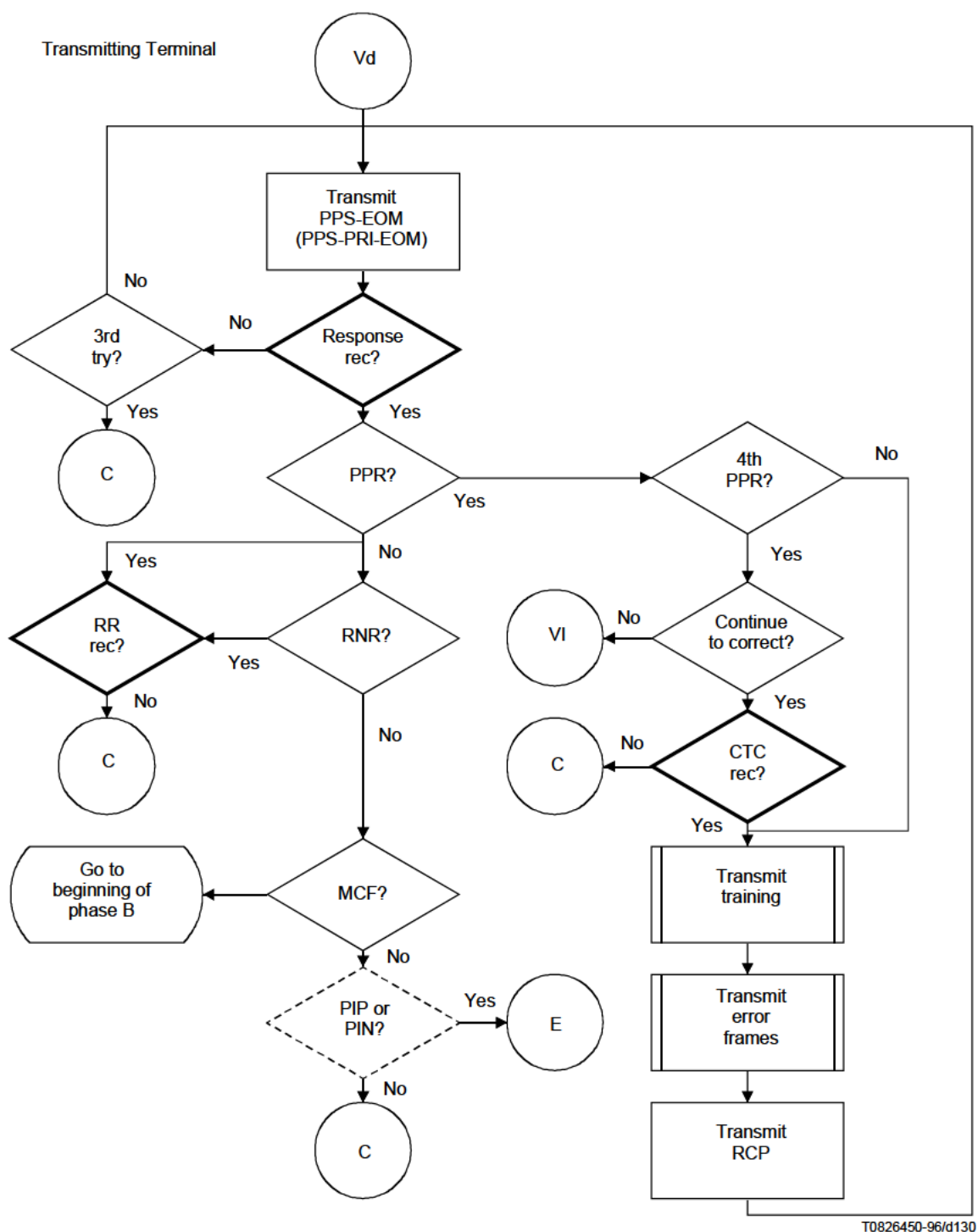


Figure G.7/T.30 (sheet 8 of 20)

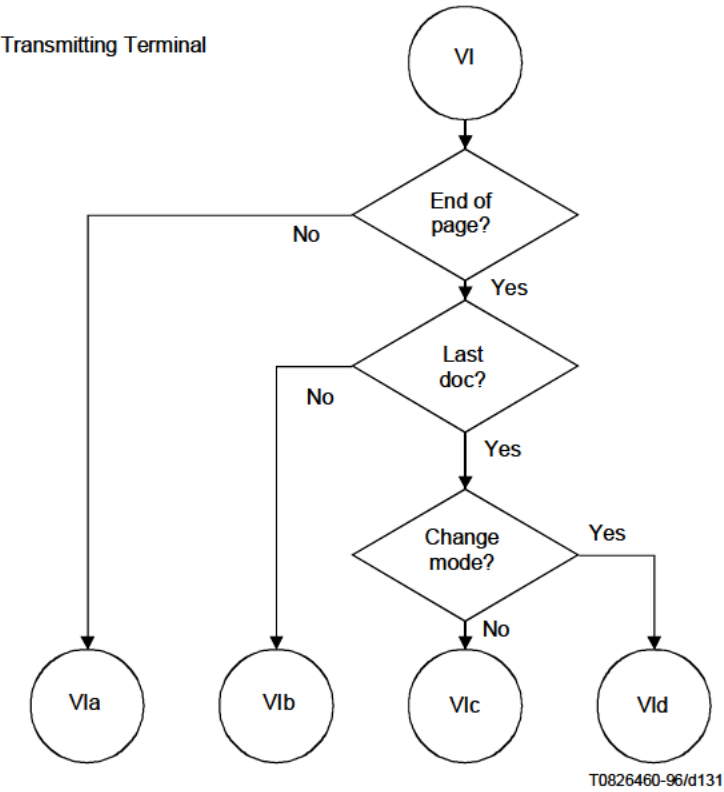


Figure G.7/T.30 (sheet 9 of 20)

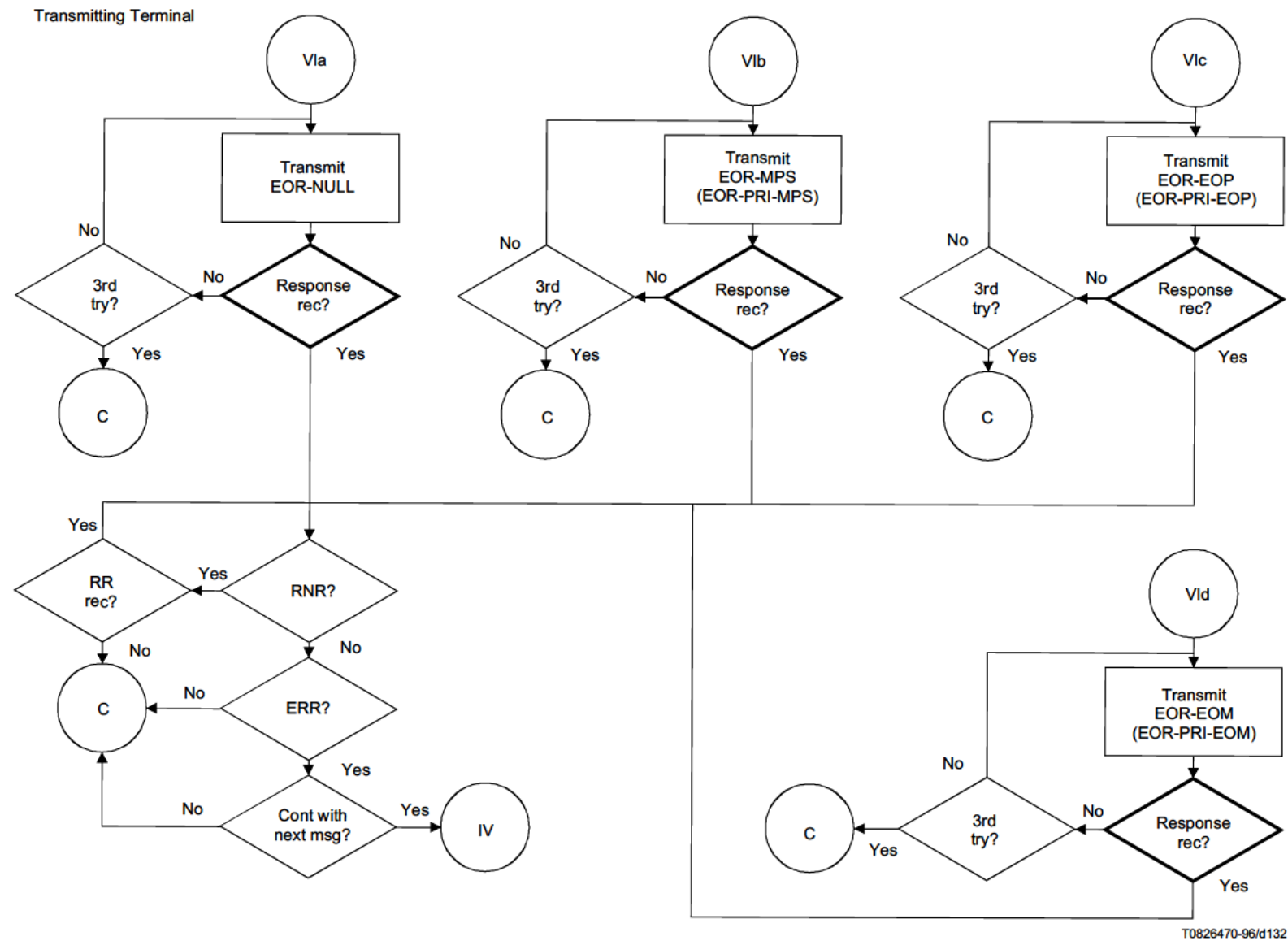


Figure G.7/ T.30 (sheet 10 of 20)

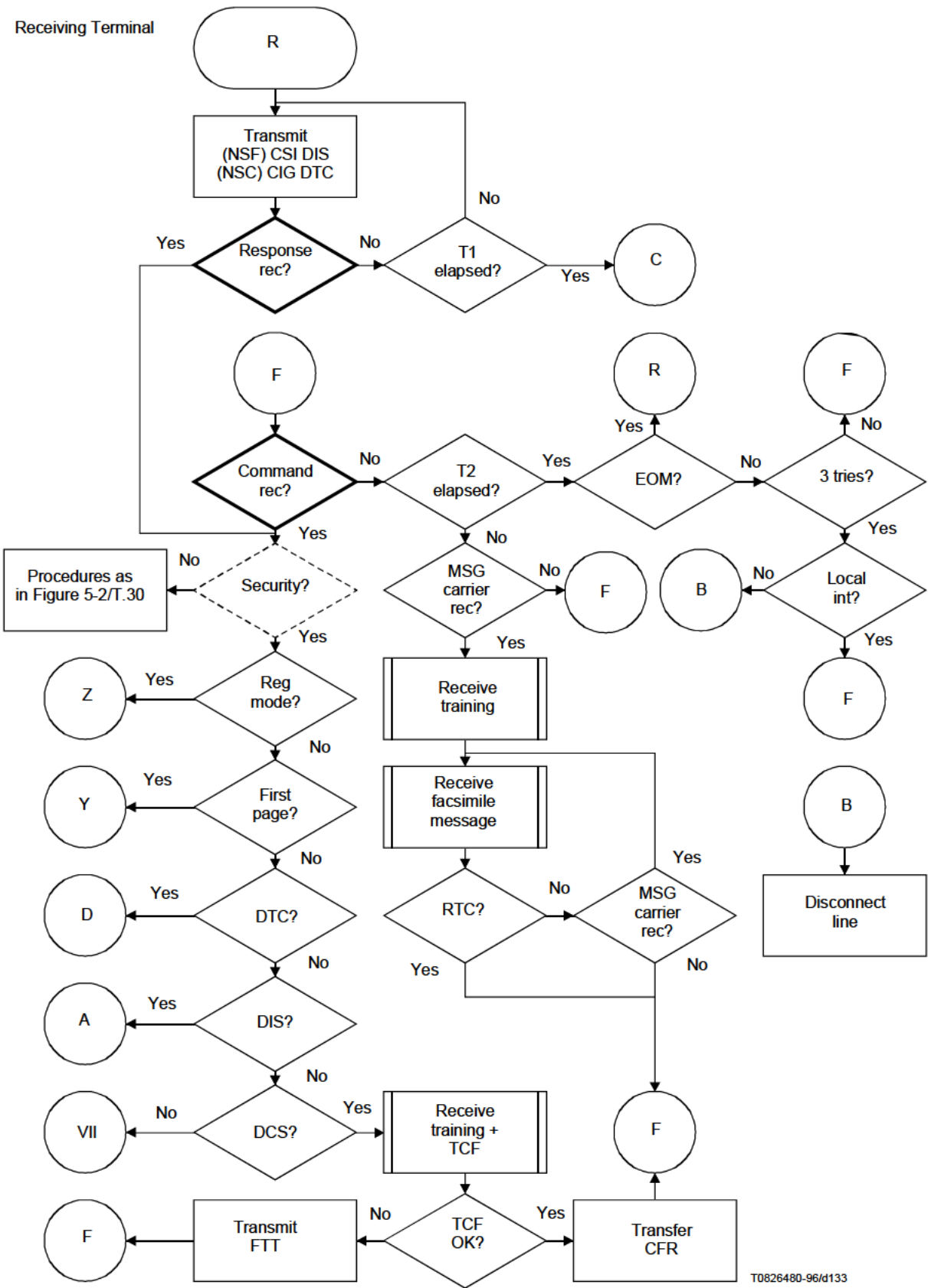


Figure G.7/T.30 (sheet 11 of 20)

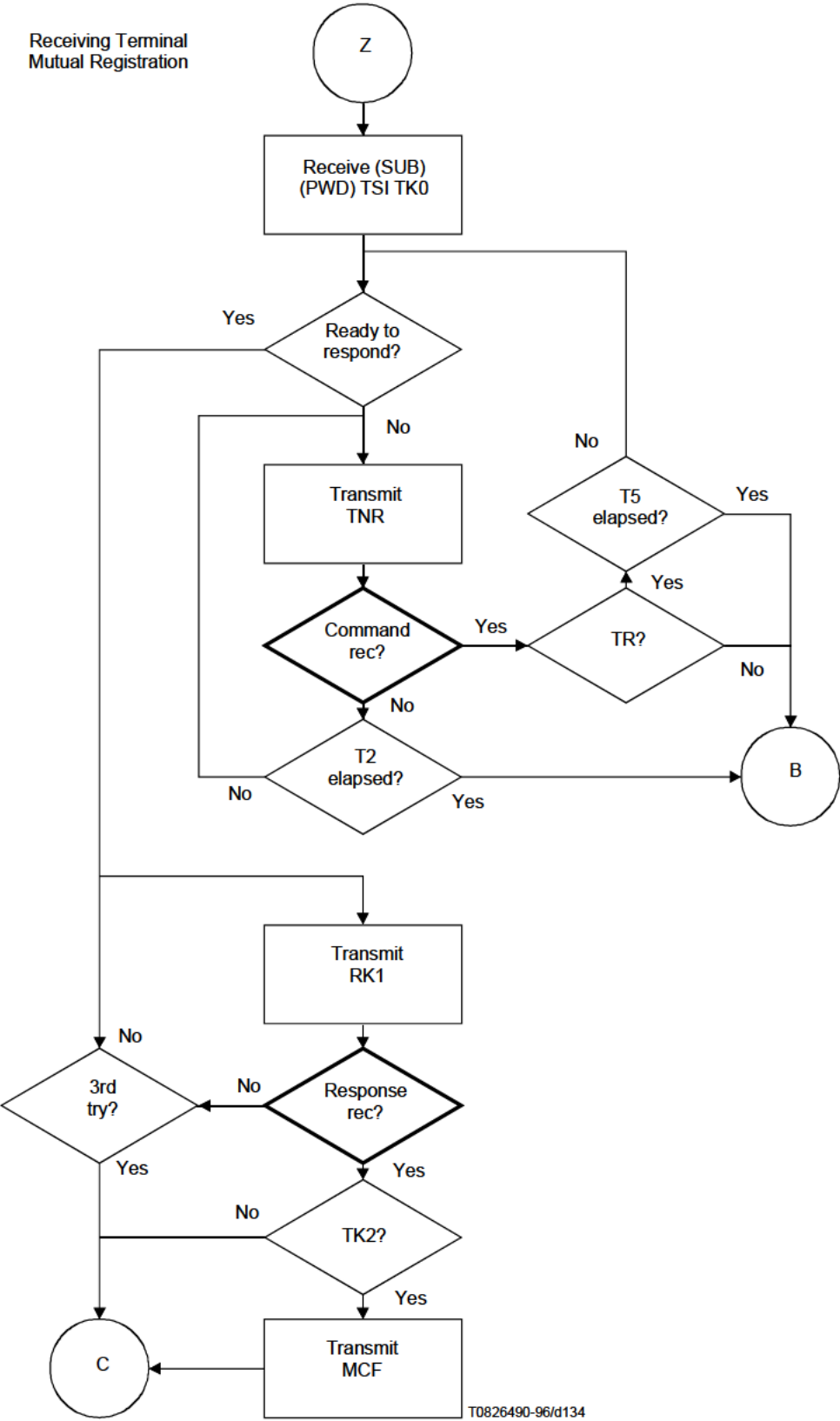


Figure G.7/T.30 (sheet 12 of 20)

Receiving Terminal

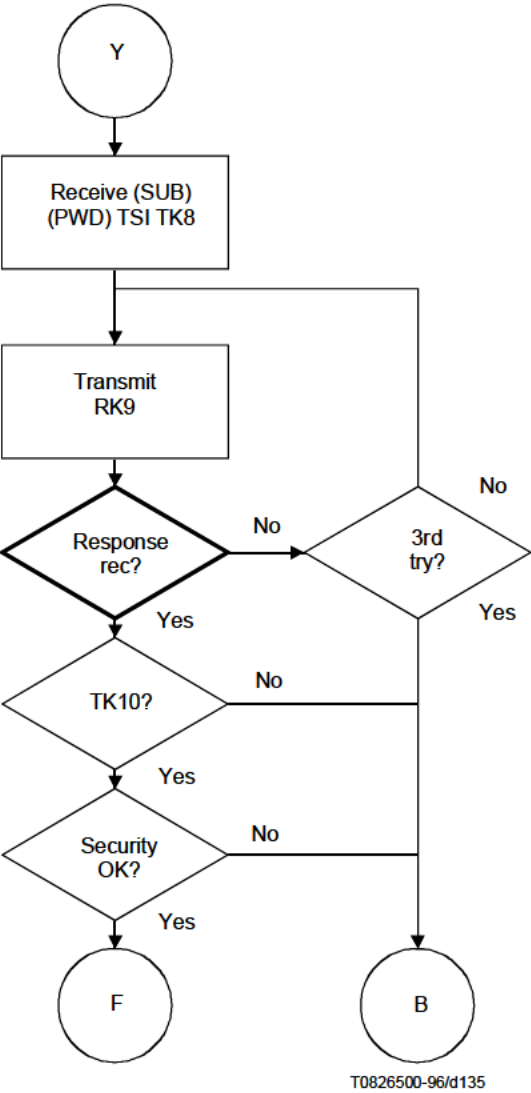


Figure G.7/T.30 (sheet 13 of 20)

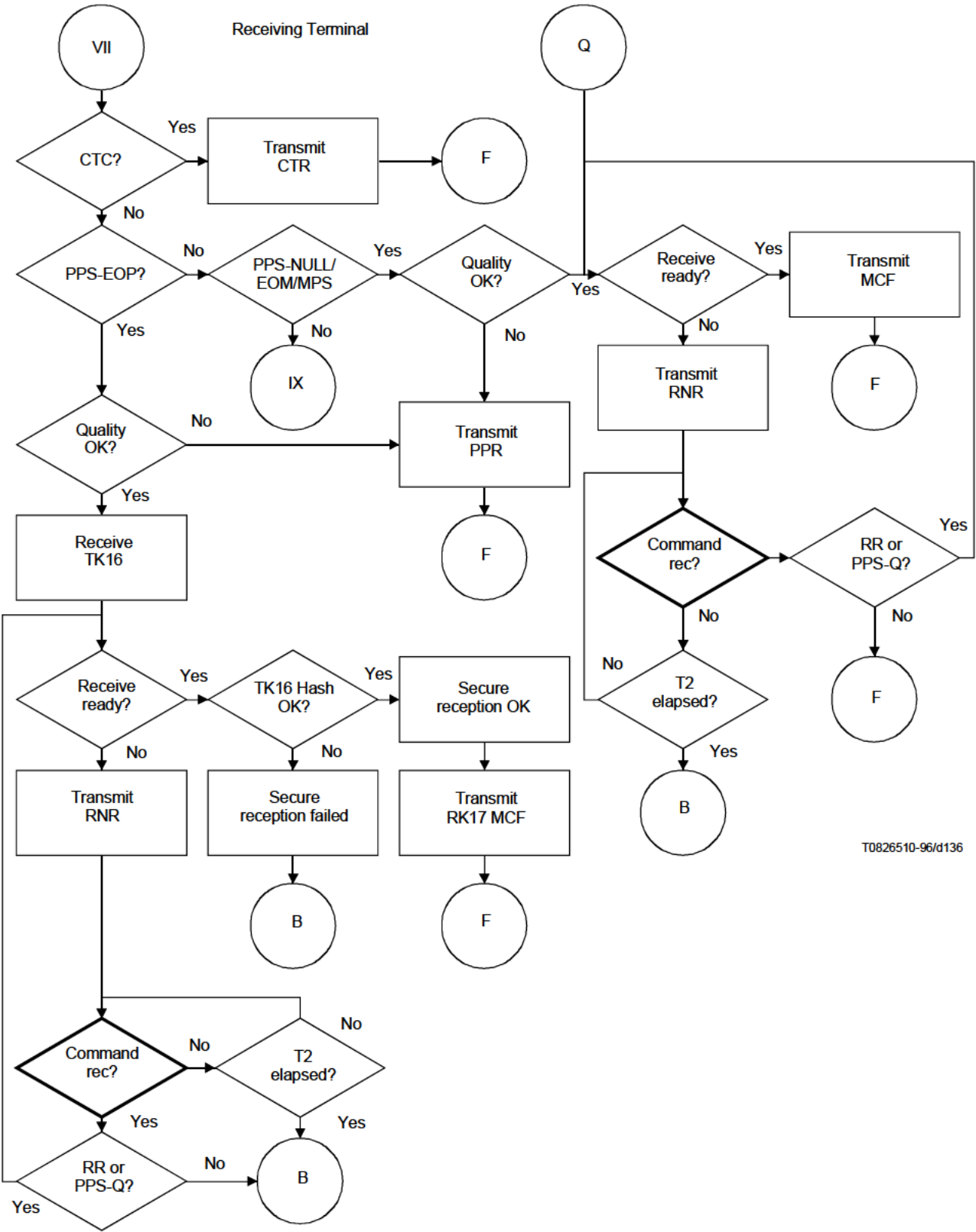


Figure G.7/T.30 (sheet 14 of 20)

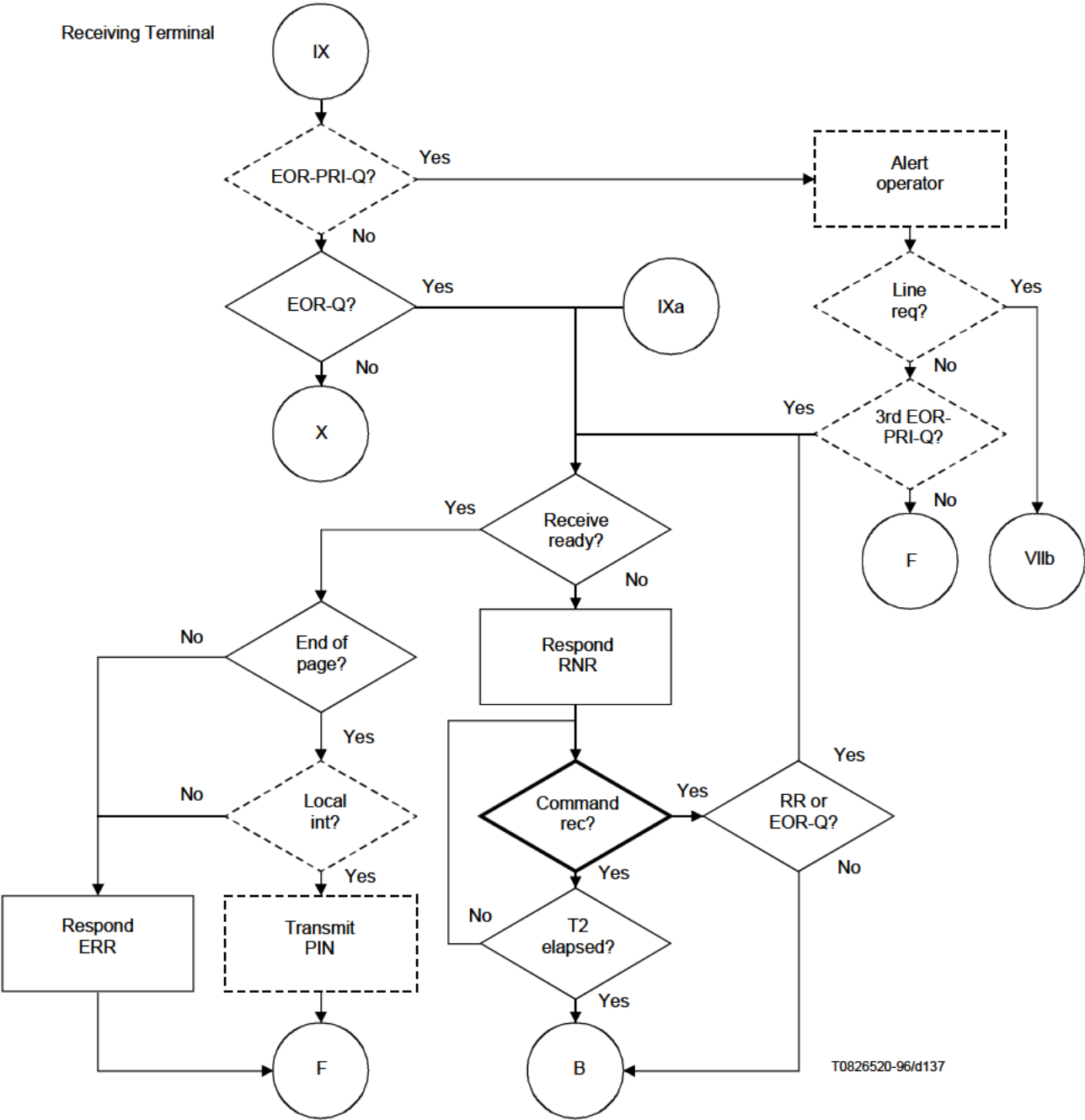


Figure G.7/T.30 (sheet 15 of 20)

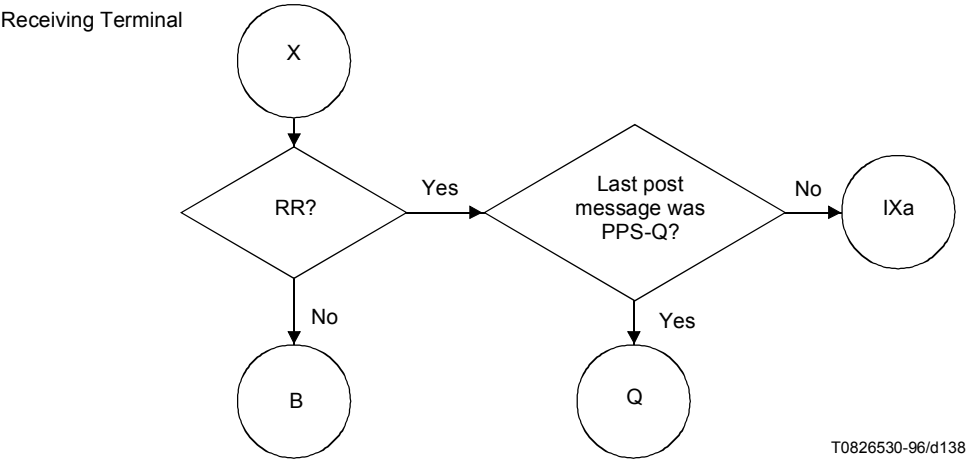


Figure G.7/T.30 (sheet 16 of 20)

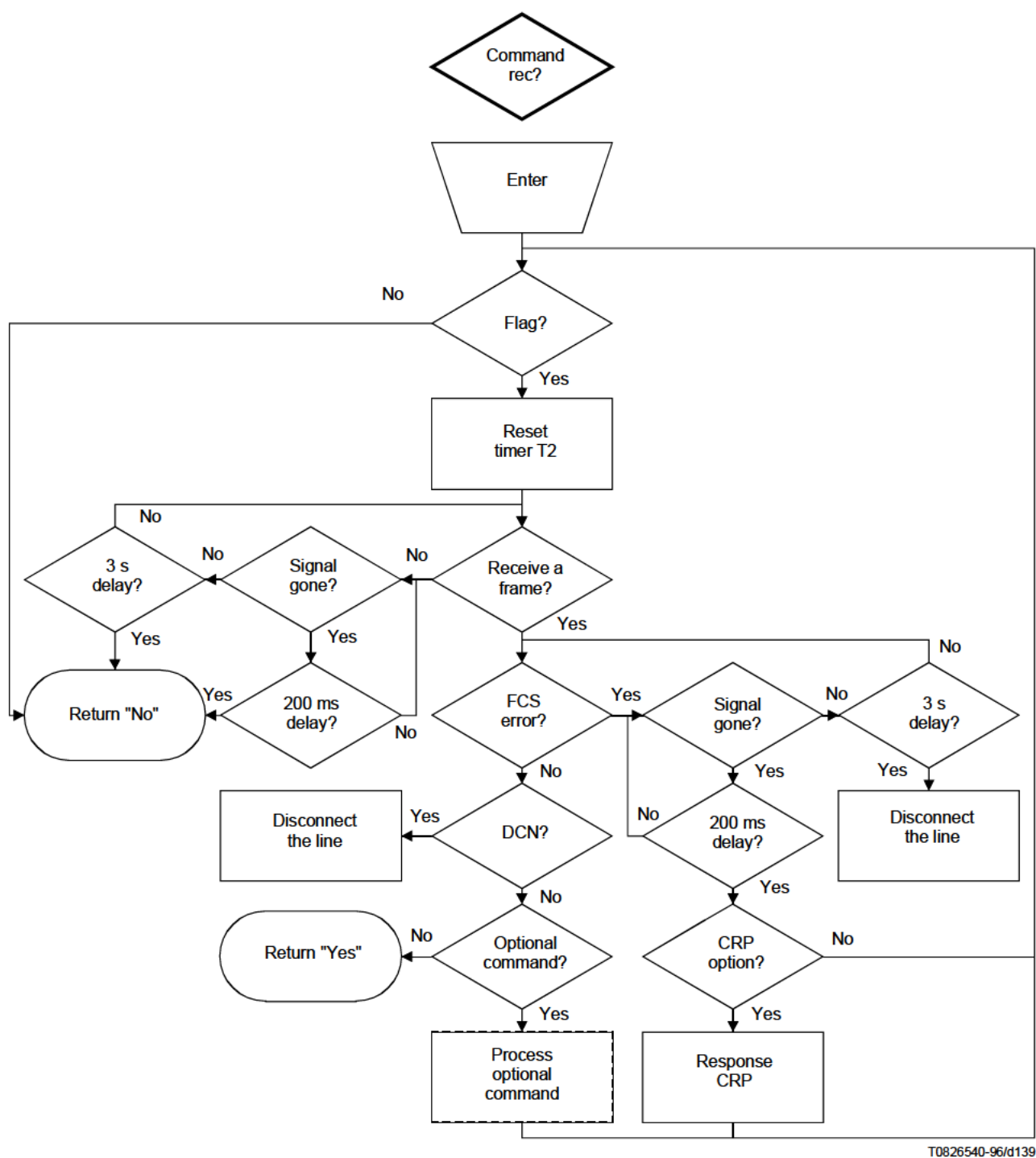


Figure G.7/T.30 (sheet 17 of 20)

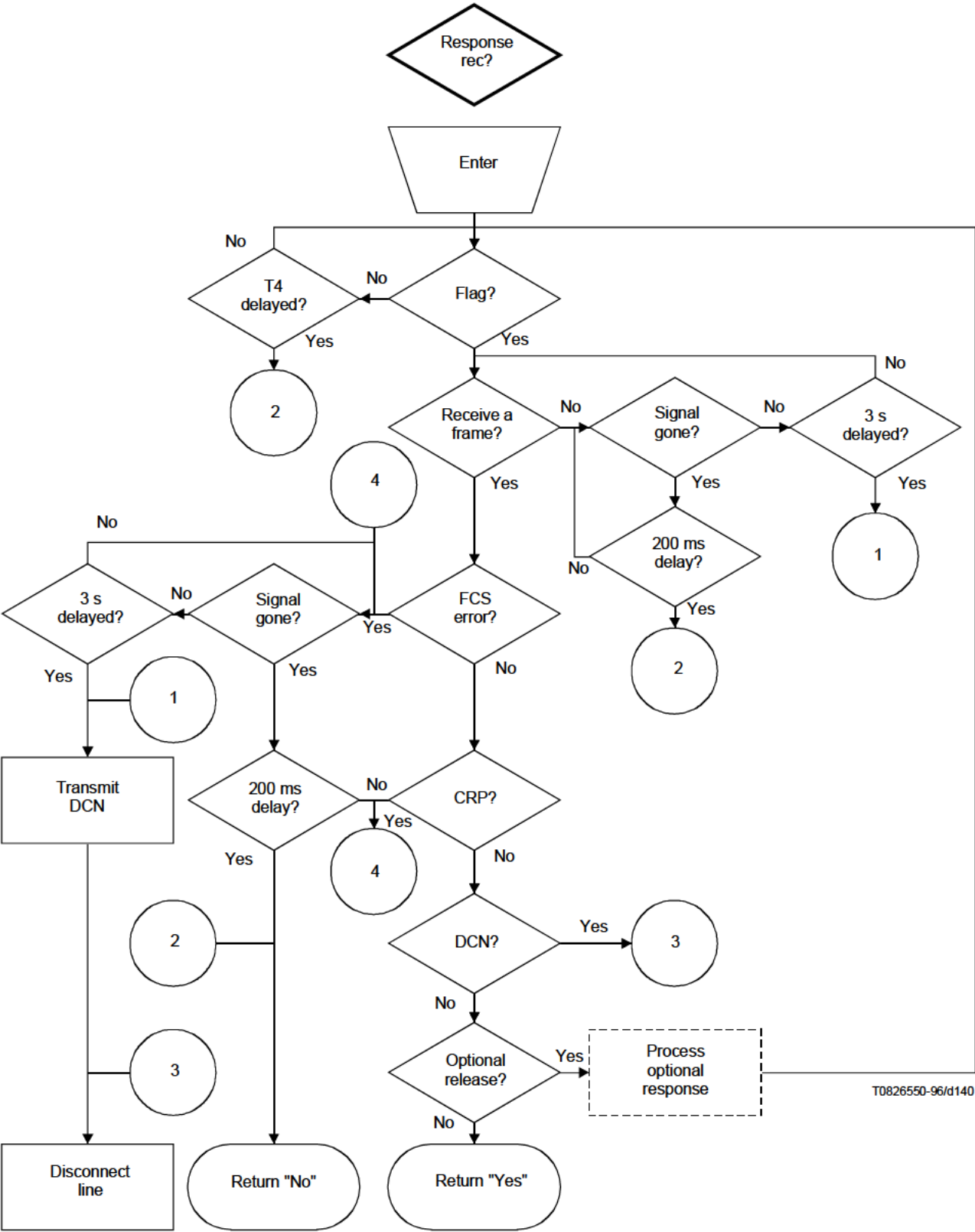


Figure G.7/T.30 (sheet 18 of 20)

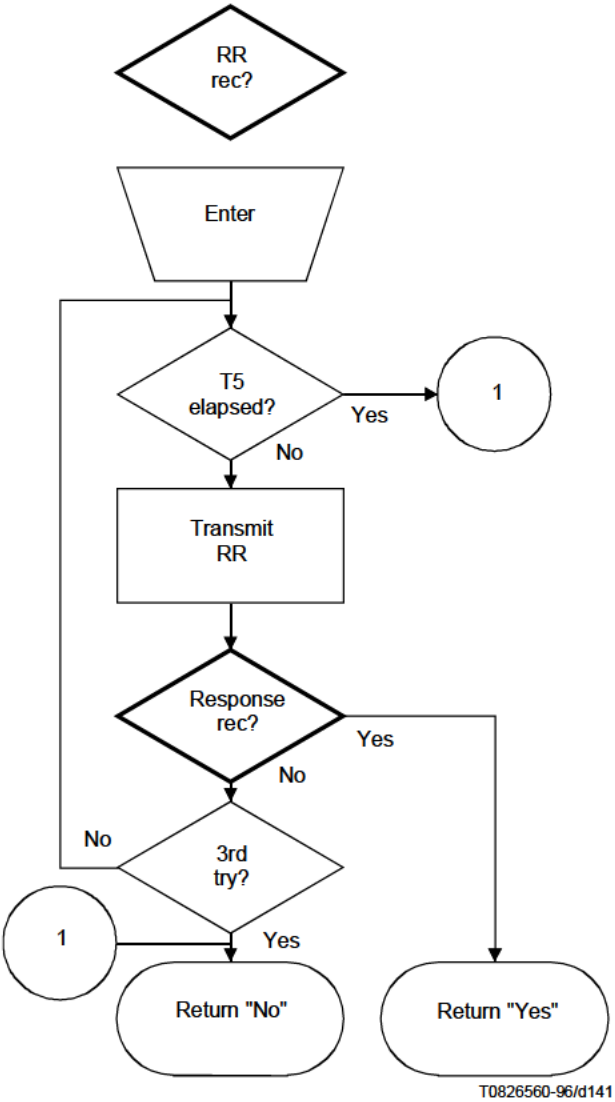


Figure G.7/T.30 (sheet 19 of 20)

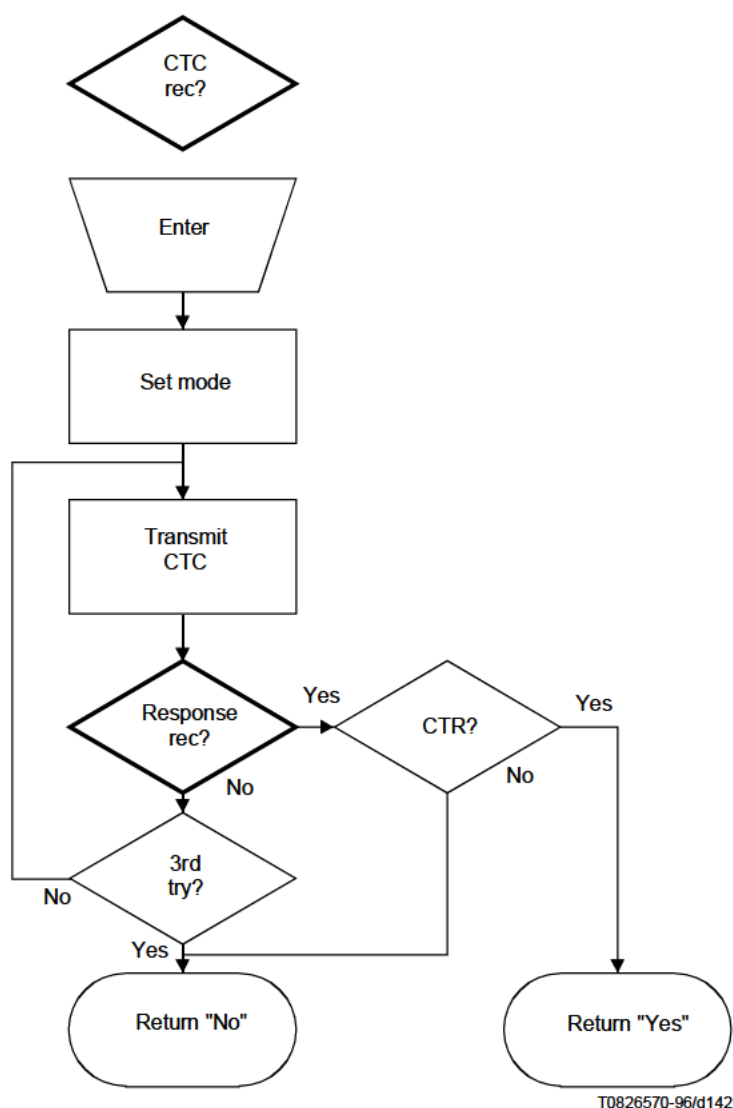


Figure G.7/T.30 (sheet 20 of 20)

G.8 Flow diagrams

G.8.1 Operation on the PSTN using the V.34 (full-duplex mode) modulation system and on the ISDN

The operation of secure document facsimile on the PSTN using the V.34 (full-duplex) modulation system and on the ISDN is exactly as defined in Annex C with the exceptions shown on the flow diagrams below.

The flow diagrams in Figure G.8 show the phase B, pre-message procedures, phase D, post-message procedure and phase E, call release, for both the transmitting and receiving terminals.

Reference should also be made to the procedures defined in ITU-T Rec. T.36.

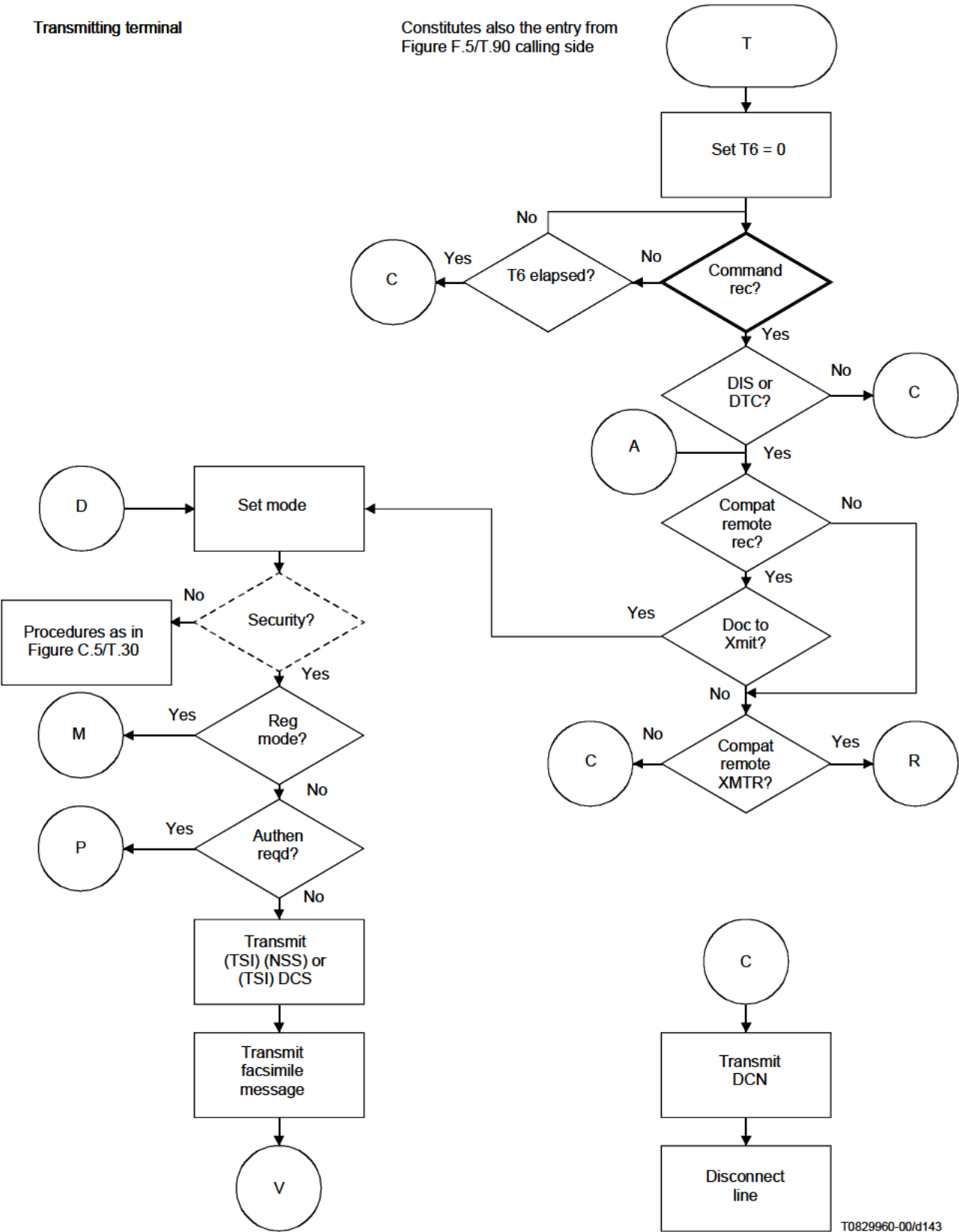
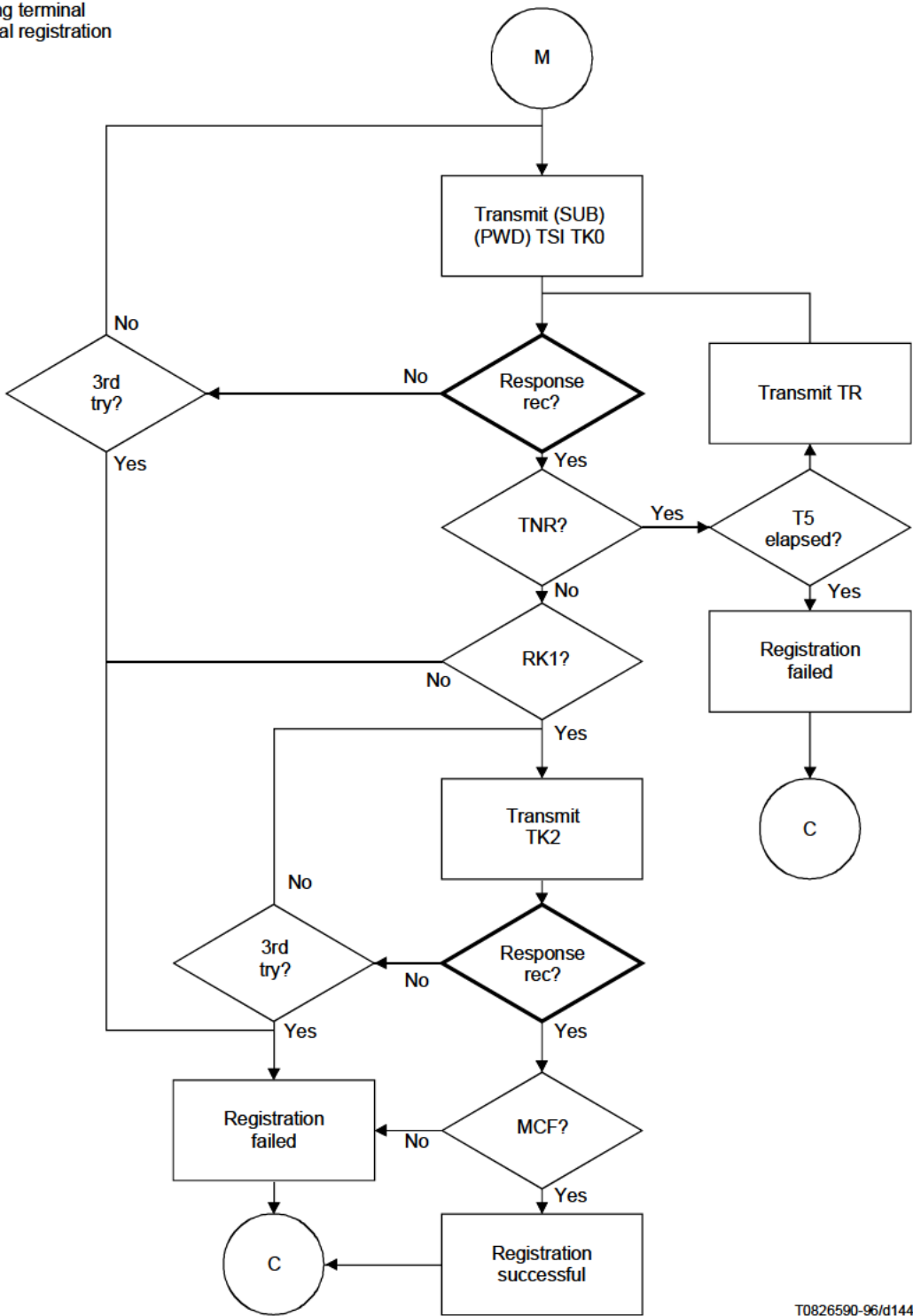


Figure G.8-1/T.30 – Duplex (sheet 1 of 3) (Used instead of Figure C.5)

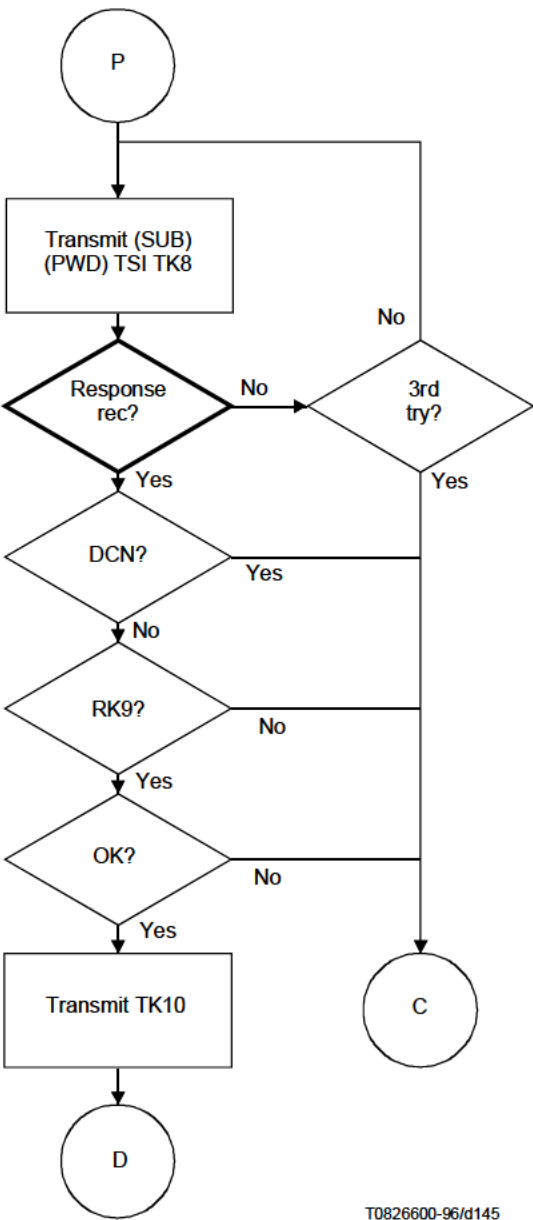
Transmitting terminal
HKM mutual registration



T0826590-96/d144

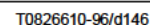
Figure G.8-1/T.30 – Duplex (sheet 2 of 3) (Used instead of Figure C.5)

Transmitting terminal



T0826600-96/d145

Figure G.8-1/T.30 – Duplex (sheet 3 of 3) (Used instead of Figure C.5)



ITU-T Rec. T.30 (09/2005)

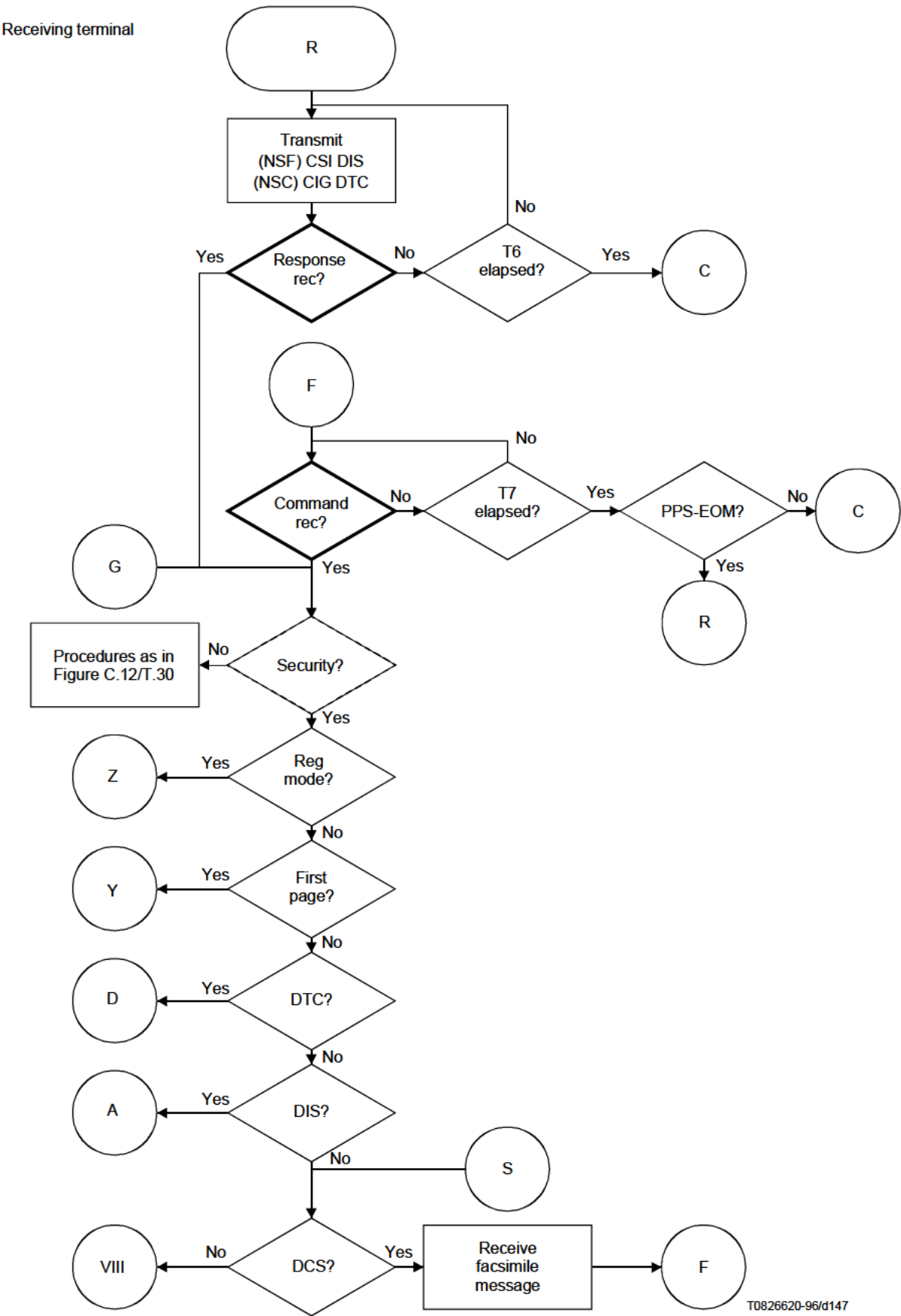
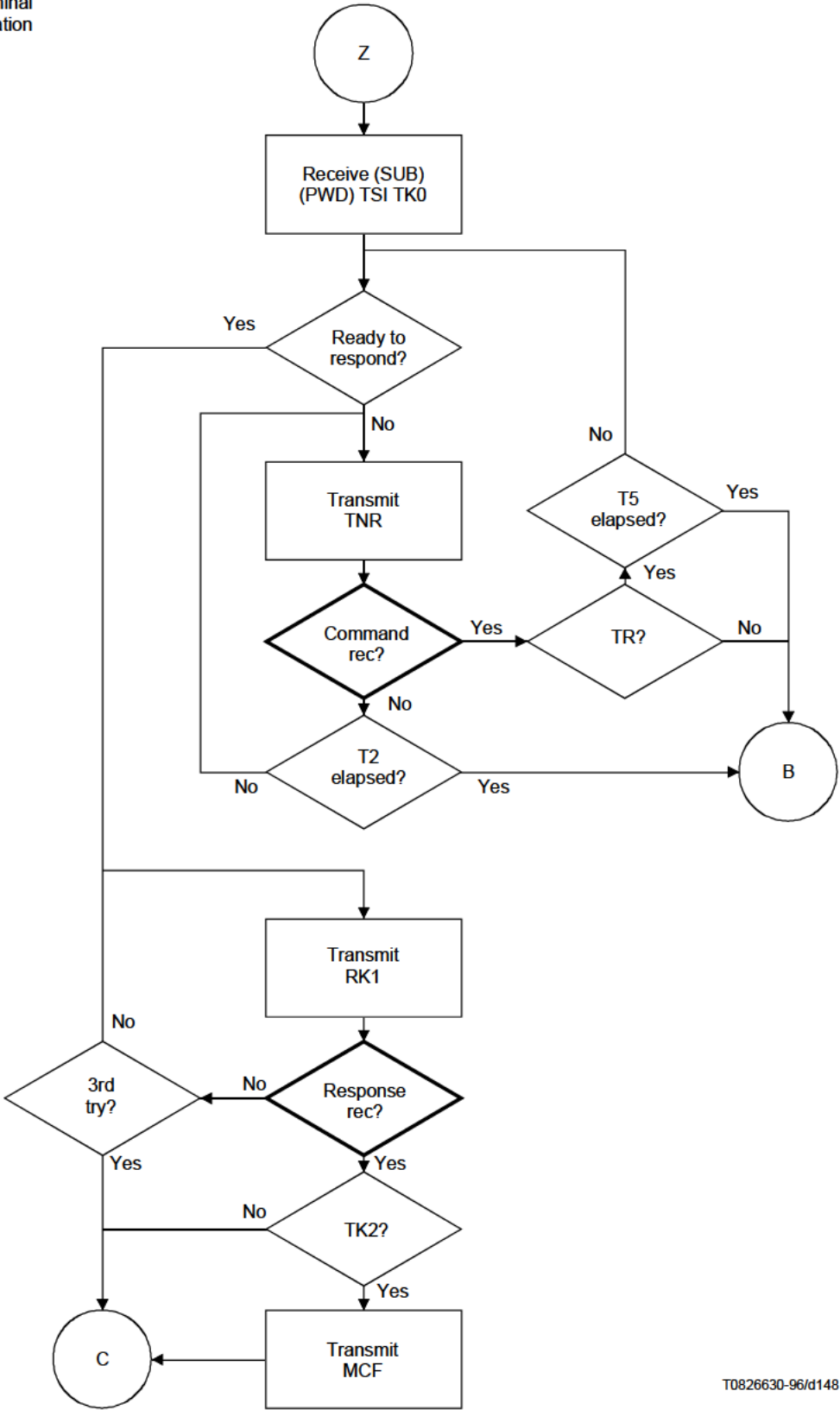


Figure G.8-3/T.30 – Duplex (sheet 1 of 3) (Used instead of Figure C.12)

Receiving terminal
mutual registration



T0826630-96/d148

Figure G.8-3/T.30 – Duplex (sheet 2 of 3) (Used instead of Figure C.12)

Receiving terminal

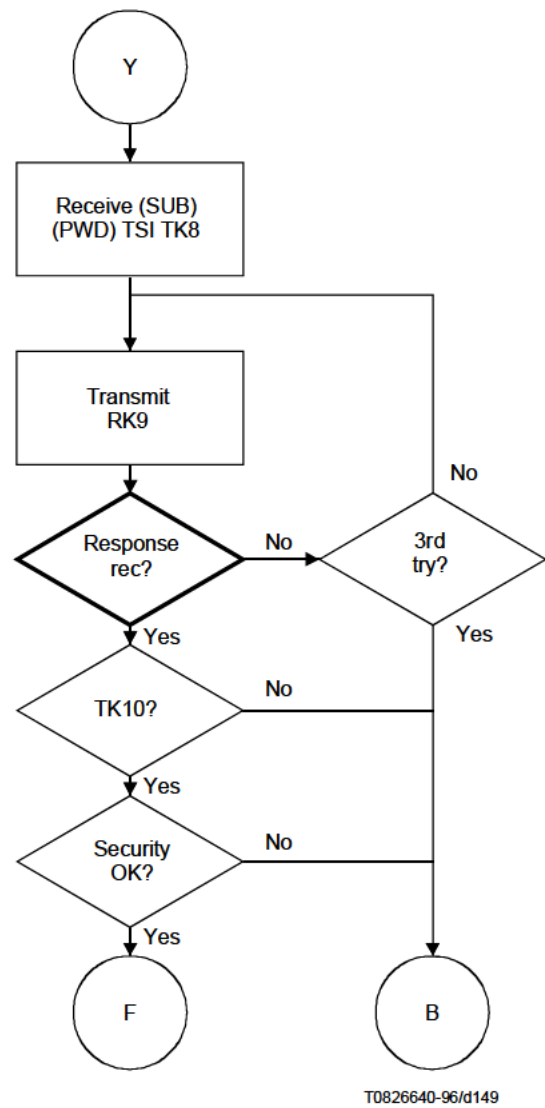
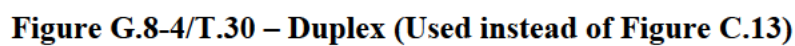


Figure G.8-3/T.30 – Duplex (sheet 3 of 3) (Used instead of Figure C.12)



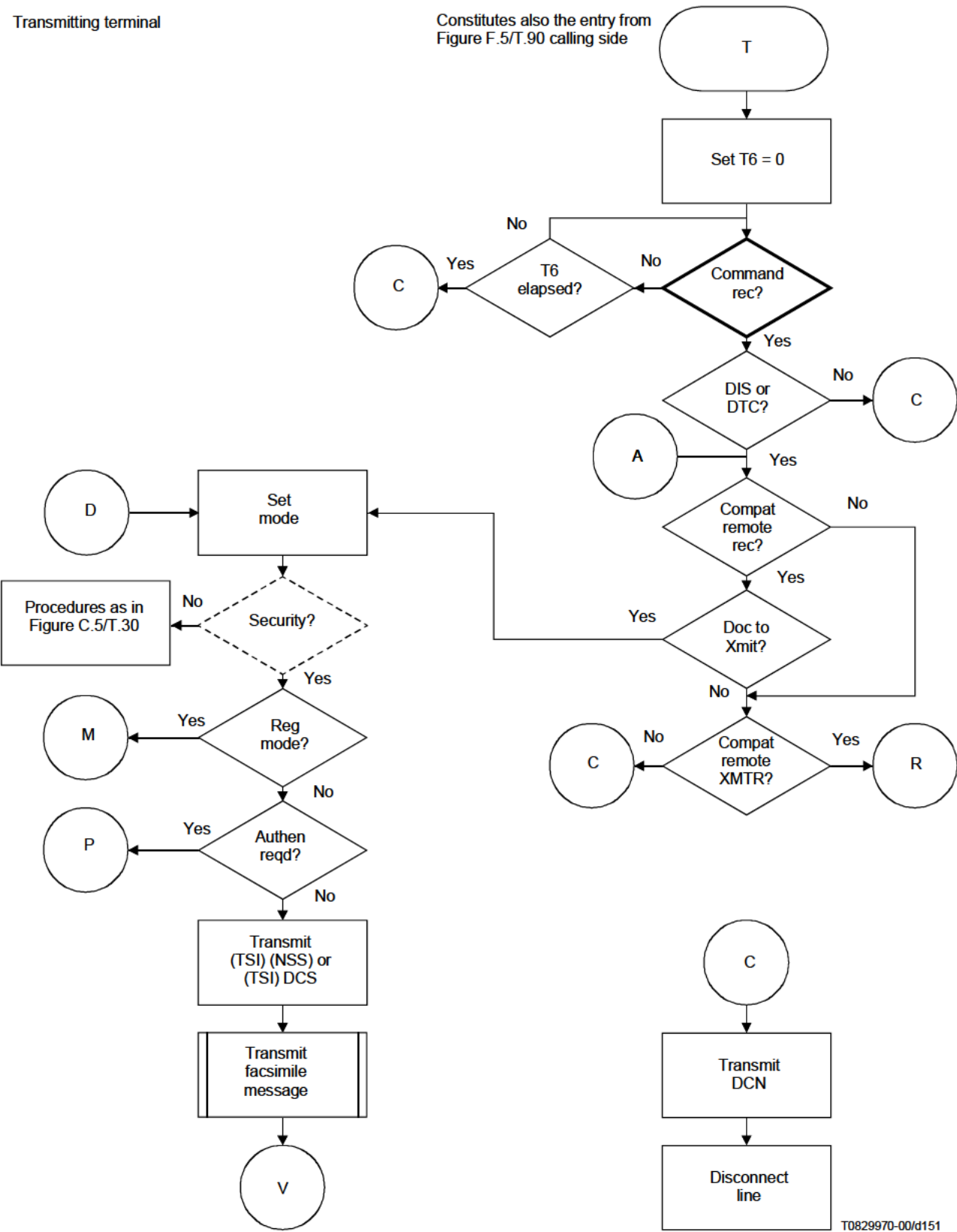
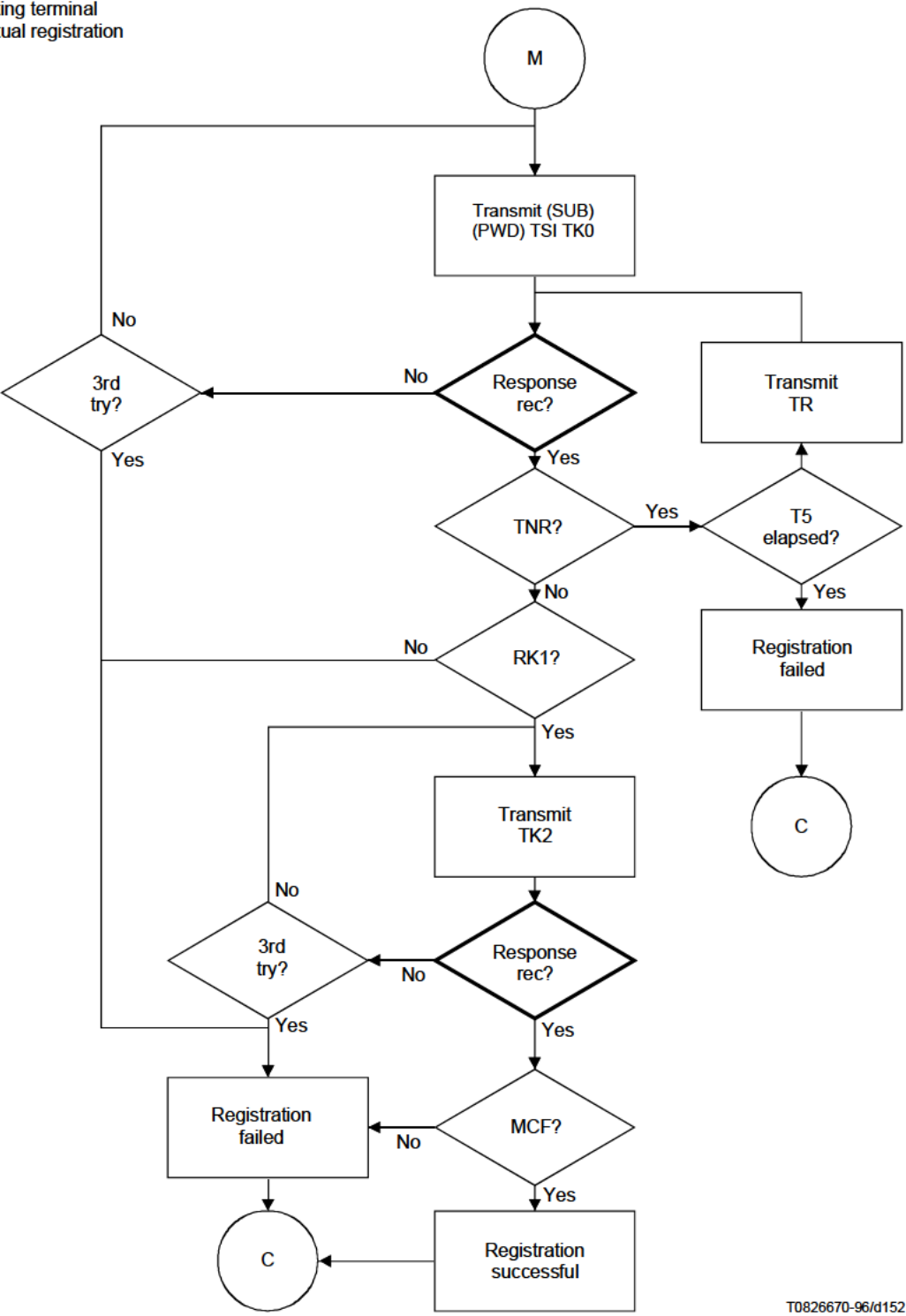


Figure G.8-5/T.30 – Duplex (sheet 1 of 3) (Used instead of Figure C.14)

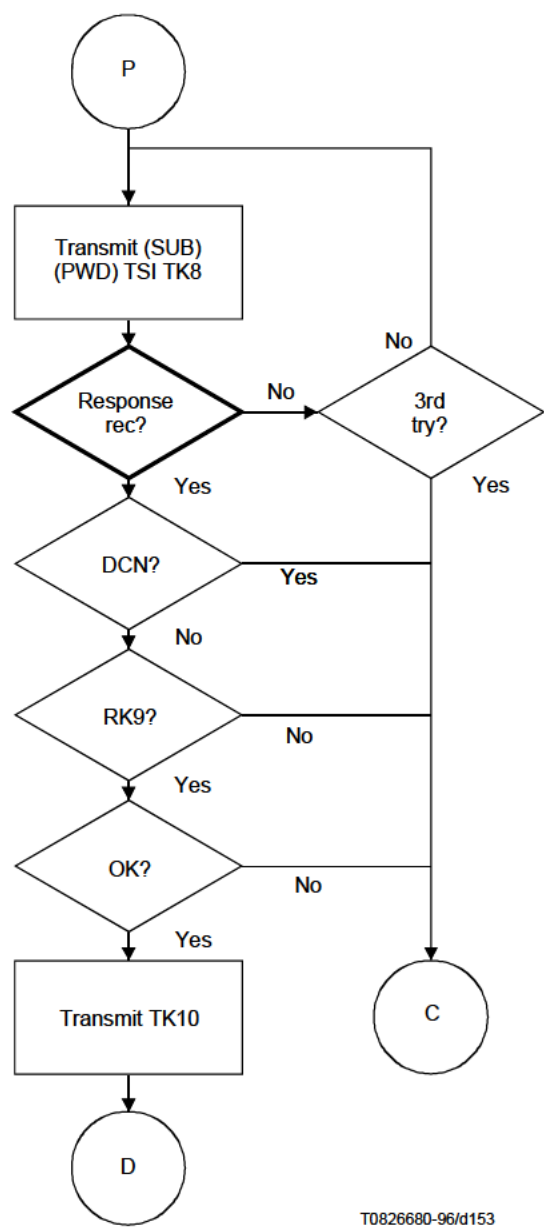
Transmitting terminal
HKM mutual registration



T0826670-96/d152

Figure G.8-5/T.30 – Duplex (sheet 2 of 3) (Used instead of Figure C.14)

Transmitting terminal



T0826680-96/d153

Figure G.8-5/T.30 – Duplex (sheet 3 of 3) (Used instead of Figure C.14)

Transmitting terminal

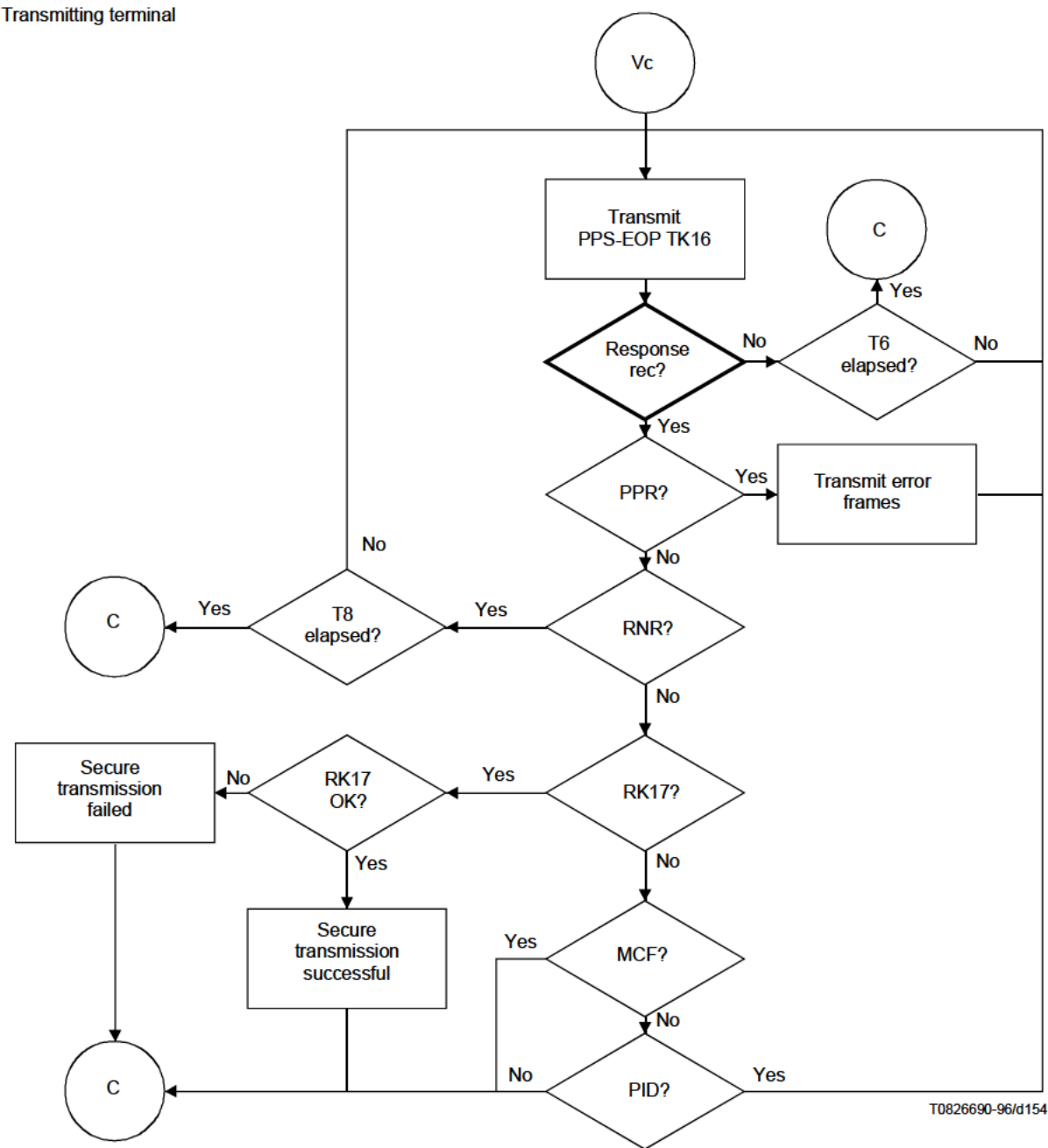


Figure G.8-6/T.30 – Duplex (Used instead of Figure C.18)

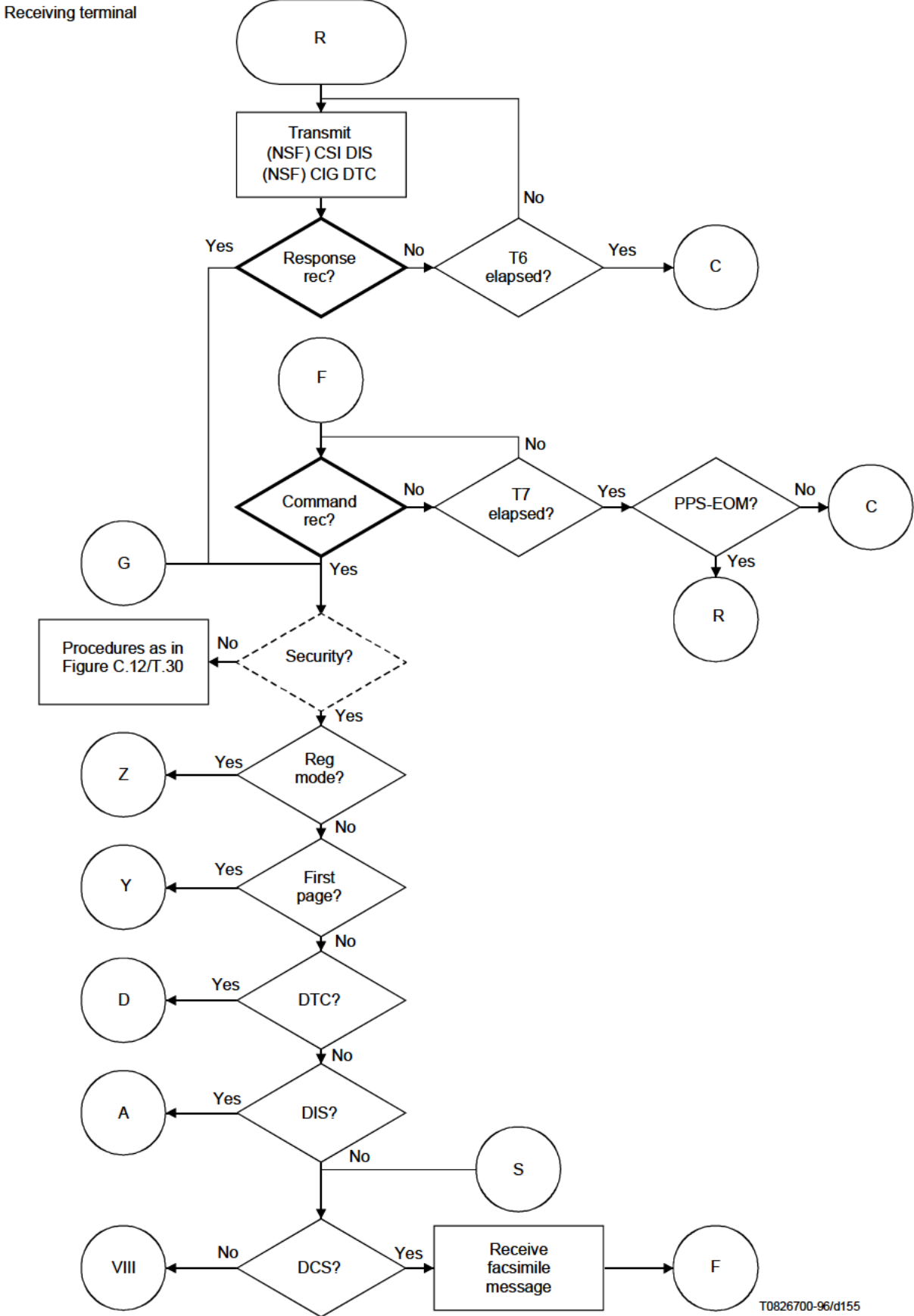


Figure G.8-7/T.30 – Duplex (Used instead of Figure C.21)

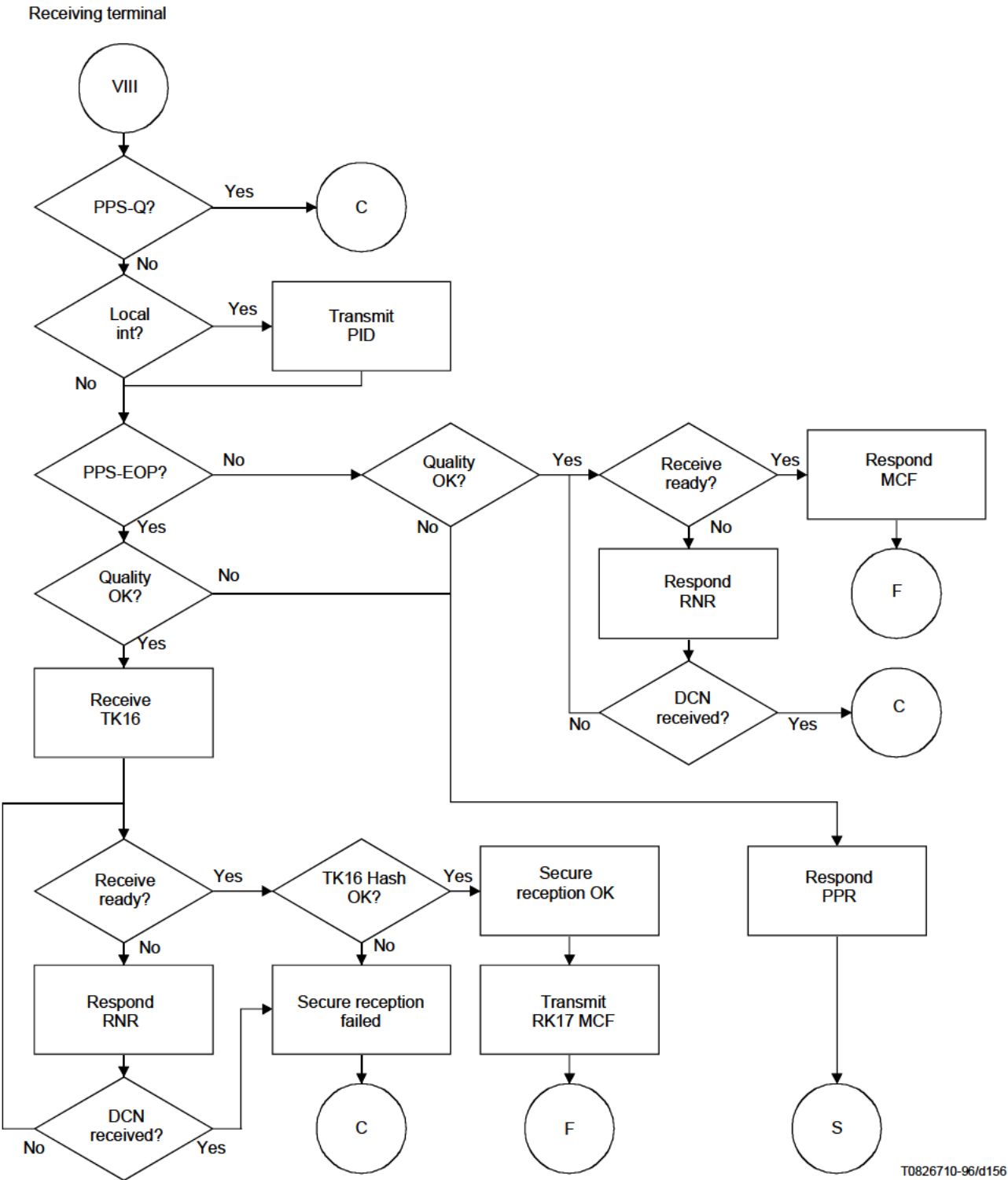


Figure G.8-8/T.30 – Duplex (Used instead of Figure C.22)

G.8.2 Flow diagram rules

The flow diagrams follow two simple rules:

- 1) All lines have an arrow at the destination only.
- 2) No lines cross.

G.8.3 Timers used in the flow diagrams

T1	35 s \pm 5 s
T2	6 s \pm 1 s
T3	10 s \pm 5 s
T4	4.5 s \pm 15% for manual units 3.0 s \pm 15% for automatic units
T5	60 s \pm 5 s
T6	5 s \pm 0.5 s
T7	6 s \pm 1 s
T8	10 s \pm 1 s
T9	Duration of 256 flags

G.8.4 Abbreviations and descriptions used in the flow diagrams

Unless defined otherwise below, the definition of the flow chart terms is as given in the main body and/or in Annex A.

Authen reqd? Check to see if mutual authentication is required at the beginning of the transmission.

NOTE 1 – Once mutual authentication has been completed, then within the same session the "No" exit should always be followed.

Reg mode? Check to see if security registration is required.

First page? Check to see if mutual authentication is required at the beginning of the transmission.

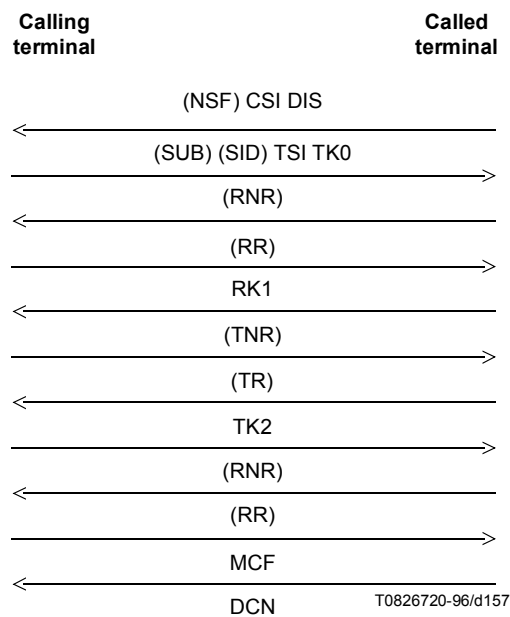
NOTE 2 – Once mutual authentication has been completed, then within the same session the "No" exit should always be followed.

G.9 Signal sequence examples in case of secure facsimile procedure

The examples in Figures G.9-1 and G.9-2 are based on the flow diagrams and are for illustrative and instructional purposes only. They should not be interpreted as establishing or limiting the protocol. The exchanges of the various signals and responses are limited only by the rules specified in this Recommendation.

NOTE – The hold-off signals, RNR/RR and TNR/TR, may be used at any time during phase B and phase D to enable the receiver or transmitter time to carry out any processing involving in calculating security values or to obtain keys from storage or, in the case of registration, from the operator.

G.9.1 HKM mutual registration



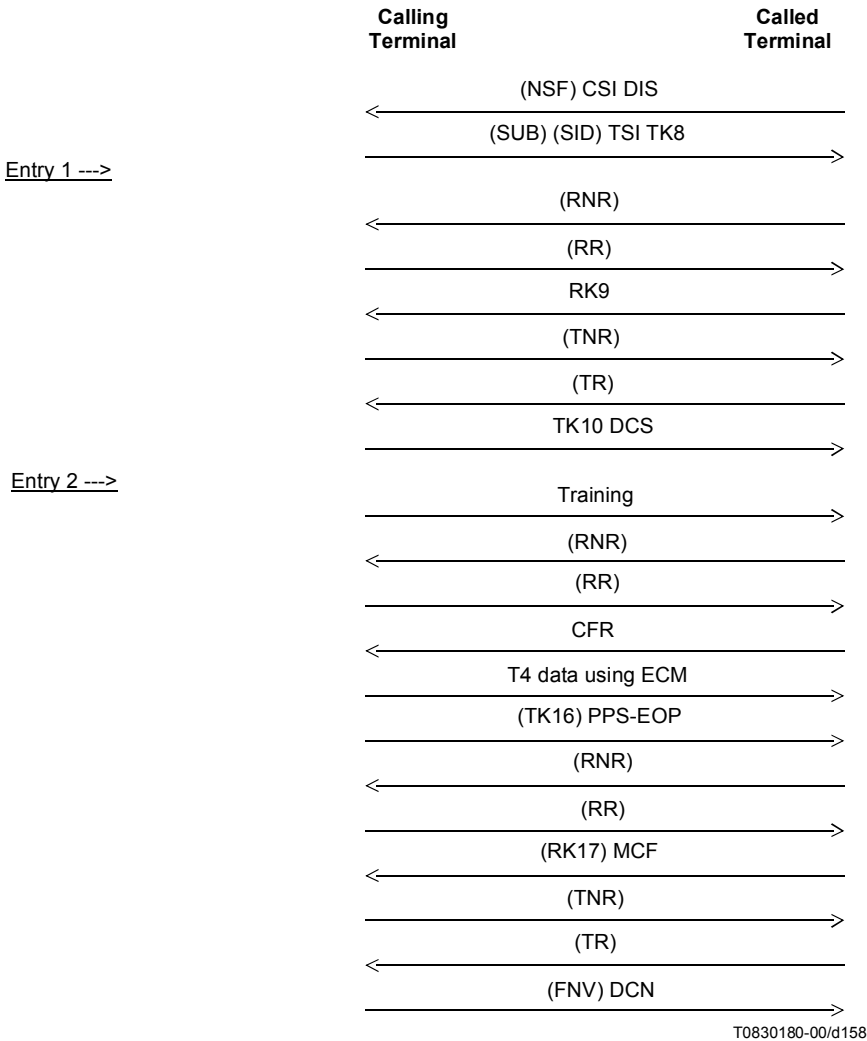
NOTE 1 – The operator of the called terminal may require time to enter the One Time key. If this is being entered manually in real time, RNR/RR is used to hold off the calling terminal. RNR/RR provides a delay of up to 65 seconds.

NOTE 2 – The SUB signal may be used to identify an individual within the domain of the called terminal with whom registration is requested.

NOTE 3 – The SID, Sender Identification, signal may be used to identify an individual within the domain of the calling terminal who is requesting the registration.

Figure G.9-1/T.30

G.9.2 HKM secure transmission with optional encryption and hashing



NOTE 1 – The SUB signal may be used to identify an individual within the domain of the called terminal to receive the secure facsimile document.

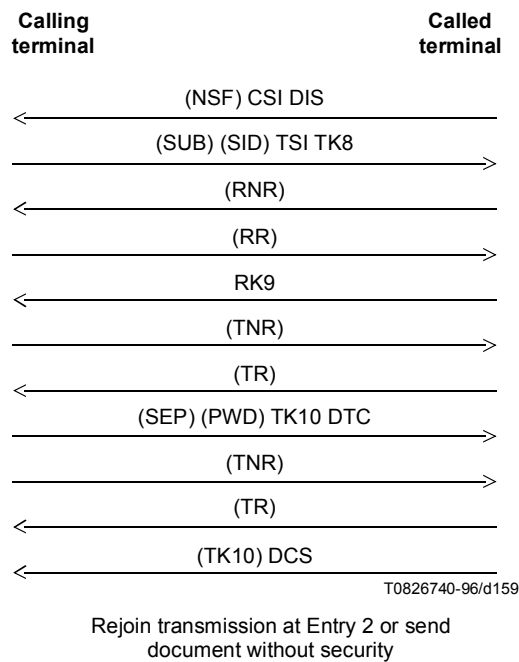
NOTE 2 – The SID, Sender Identification, signal may be used to identify an individual within the domain of the calling terminal who is sending the secure facsimile document.

NOTE 3 – Data to be transmitted should be in exactly the same format as it would be if encryption was not being used, i.e., complete with any padding, etc. Encryption takes place immediately before these data are actually transmitted. When the receiving terminal decrypts the data, it should do so immediately before normal processing.

Figure G.9-2/T.30

G.9.3 HKM secure polling with optional encryption and hashing

See Figure G.9-3.



NOTE 1 – The SUB signal may be used to identify an individual within the domain of the called terminal to receive the secure facsimile document.

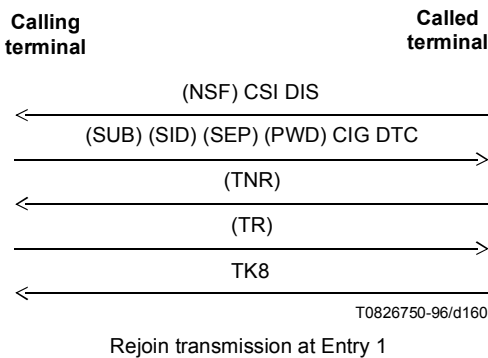
NOTE 2 – The SID, Sender Identification, signal may be used to identify an individual within the domain of the calling terminal who is sending the secure facsimile document.

NOTE 3 – Data to be transmitted should be in exactly the same format as it would be if encryption was not being used, i.e., complete with any padding, etc. Encryption takes place immediately before these data are actually transmitted. When the receiving terminal decrypts the data, it should do so immediately before normal processing.

Figure G.9-3/T.30

G.9.4 HKM secure polling (initiated by polled system) with optional encryption and hashing

See Figure G.9-4.



NOTE 1 – The SUB signal may be used to identify an individual within the domain of the called terminal to provide the secure facsimile document.

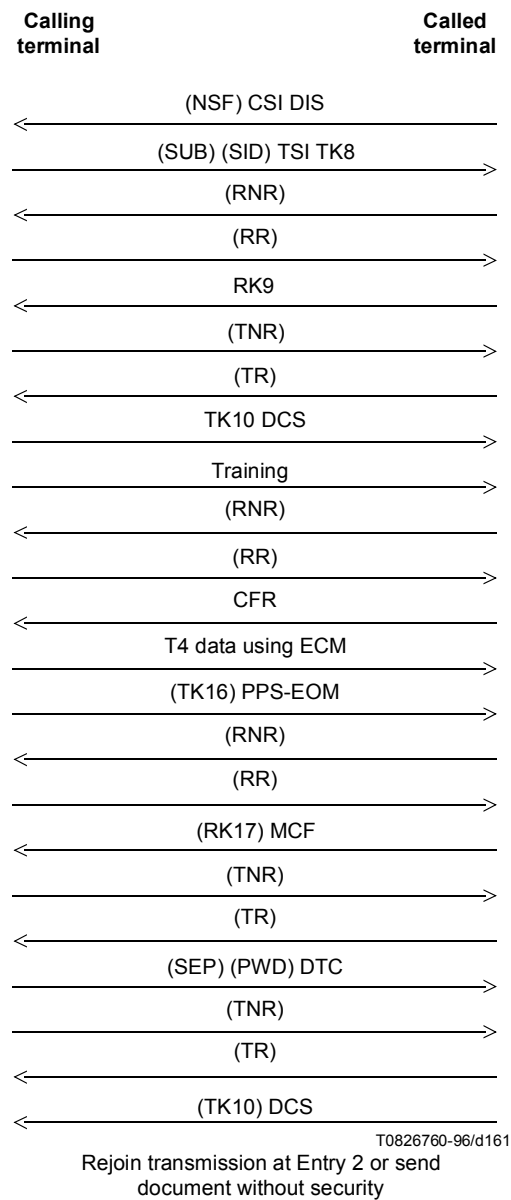
NOTE 2 – The SID, Sender Identification, signal may be used to identify an individual within the domain of the calling terminal who is polling the secure facsimile document.

NOTE 3 – Data to be transmitted should be in exactly the same format as it would be if encryption was not being used, i.e., complete with any padding, etc. Encryption takes place immediately before these data are actually transmitted. When the receiving terminal decrypts the data, it should do so immediately before normal processing.

Figure G.9-4/T.30

G.9.5 HKM secure turnaround poll with optional encryption and hashing

See Figure G.9-5.



NOTE 1 – The SUB signal may be used to identify an individual within the domain of the called terminal to receive the secure facsimile document.

NOTE 2 – The SID, Sender Identification, signal may be used to identify an individual within the domain of the calling terminal who is sending the secure facsimile document.

NOTE 3 – Data to be transmitted should be in exactly the same format as it would be if encryption was not being used, i.e., complete with any padding, etc. Encryption takes place immediately before these data are actually transmitted. When the receiving terminal decrypts the data, it should do so immediately before normal processing.

NOTE 4 – TK10 is optional and, if present, will contain a new session key with the response values set to zero.

Figure G.9-5/T.30

Annex H

Security in facsimile G3 based on the RSA algorithm

H.1 Preamble

(The preamble is left blank on purpose.)

H.2 Introduction

This annex specifies the mechanisms to offer security features based on the RSA cryptographic mechanism. The coding scheme of the document transmitted with security features may be of any kind defined in Recs T.4 and T.30 (Modified Huffman, MR, MMR, Character mode as defined in Annex D/T.4, BFT, other file transfer mode defined in Annex C/T.4).

H.3 References

- FIPS PUB 186-2: Digital Signature Standard, *U.S NIST*, 27 January 2000.
- ISO/IEC 9796-2:2002, *Information technology – Security techniques – Digital signature schemes giving message recovery – Part 2: Integer factorization based mechanisms*.
- ISO/IEC 9796-3:2000, *Information technology – Security techniques – Digital signature schemes giving message recovery – Part 3: Discrete logarithm based mechanisms*.
- RIVEST (R.L.), SHAMIR (A.), ADLEMAN (L.), A method for obtaining digital signatures and public-key cryptosystems, *CACM (Communications of the ACM)*, Vol. 21, No. 2, pp. 120-126, 1978.
- ISO/IEC 9979:1999, *Information technology – Security techniques – Procedures for the registration of cryptographic algorithms*.
- ISO/IEC 10118-3:2004, *Information technology – Security techniques – Hash-functions – Part 3: Dedicated hash-functions*.
- FIPS PUB 180-1: *Secure Hash Standard*, April 1995.
- ISO/IEC 14888-3:1998, *Information technology – Security techniques – Digital signatures with appendix – Part 3: Certificate-based mechanisms*.
- RFC 1321 (1992), *The MD5 message-digest algorithm*.

H.4 Security mechanisms

H.4.1 Digital signature mechanism and keys management

The basic algorithm used for the digital signature (authentication and integrity type services) is the **RSA**.

The couple of keys used for this purpose is "public key"/"secret key".

When the optional confidentiality service is offered, the token containing the session key "Ks", used for enciphering the document, is encrypted also by the means of RSA algorithm. The couple of keys used for this purpose called ("encipherment public key"/"encipherment secret key") is not the same one as that used for authentication and integrity types services. This is for decoupling the two kinds of use.

The implementation of RSA which is used in this annex is described in ISO/IEC 9796 (Digital signature scheme giving message recovery).

For encipherment of the token containing the session key, the rules of redundancy when processing the algorithm RSA are the same ones as those specified in ISO/IEC 9796.

NOTE – Certain Administrations in addition to RSA (which is the basic mechanism in the context of this annex), may require that an optional mechanism be implemented: the DSA.

H.4.2 Length of the public keys, secret keys and digital signatures

As a basic feature, the length of the public keys, secret keys and digital signatures is **512 bits**. Longer lengths may be used as recognized options; they are negotiated through the protocol (see further).

H.4.3 Length of the public exponent of RSA

For digital signatures, the public exponent has a fixed value equal to 3.

For encipherment of the token which includes the session key "Ks", the public exponent has a fixed value equal to: $2^{16} + 1$. The session key is used in case of encipherment of the document, see further.

H.4.4 Certification authorities

By default, certification authorities are not used.

As an option, certification authorities may be used to certificate the validity of the public key of the sender of the facsimile message. In such a case, the public key may be certified as specified in ITU-T Rec. X.509.

The means to transmit the certificate of the public key of the sender is described in this annex, but the precise format of the certificate is left for further study (in future versions of this annex).

The actual transmission of the certificate is negotiated in the protocol.

H.4.5 Registration mode

As a **mandatory** feature, a *registration mode* is provided. It permits the sender and the receiver to register and store the public keys of the other party in confident manner prior to any secure facsimile communication between the two parties.

Registration mode can avoid the need for the user to enter manually in the terminal the public keys of its correspondents (the public keys are fairly long, 64 octets or more).

Because the registration mode permits to exchange the public keys and store them in the terminals, it is not necessary to transmit them during the facsimile communications.

The scheme of the registration mode is detailed further in this annex.

H.4.6 Hash function

As described in this annex, some signatures are applied on the result of a "hash function".

The hash function which is used is either (SHA-1, *Secure Hash Algorithm 1*), an algorithm which comes from the "NIST" in USA or MD-5 (RFC 1321).

For SHA-1, the length of the result of the hashing process is on **160 bits**.

For MD-5, the length of the result of the hashing process is on **128 bits**.

A terminal may implement either SHA-1 or MD-5 or both.

The use of one algorithm or the other is negotiated in the protocol (see further).

In the future, other optional hash functions may be added in this annex.

H.4.7 Encipherment

H.4.7.1 General

The encipherment of the data for provision of the confidentiality service is optional. Five optional encipherment schemes are registered in the scope of this annex:

FEAL-32, SAFER K-64, RC5, IDEA and HFX40 (as described in ITU-T Rec. T.36). In some countries, their use may be subject to national regulation.

Other optional algorithms could be registered in the future.

Other optional algorithms may also be used. They are chosen conforming to the ISO/IEC 9979 (Procedure for registering cryptographic algorithms).

The capability of the terminal to handle one of these algorithms and the actual use of a particular one during the communication is negotiated in the protocol.

A session key is used for encipherment. The session key is called "**Ks**".

The basic length of "**Ks**" is 40 bits.

- For algorithms which use a 40-bit session key (e.g., HFX40), the session key "**Ks**" is the key actually used in the encipherment algorithm.
- For algorithms which require keys longer than 40 bits (e.g., FEAL-32, IDEA, SAFER K-64 requiring respectively: 64 bits, 128 bits and 64 bits), a redundancy mechanism is performed to get the necessary length. The resultant key is called the "redundant session key". The "redundant session key" is the key which is actually used in the encipherment algorithm.

The redundancy mechanism is described in the next clause.

The token "**BE**" which includes "**Ks**" (see further) is enciphered by the "encipherment public key" of the recipient and sent to it by the sender.

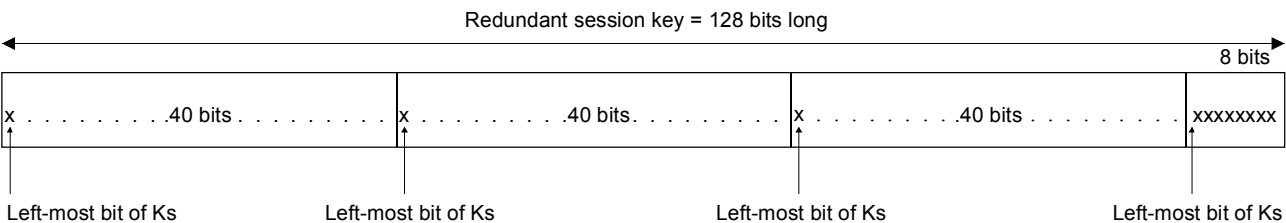
When a redundancy key is necessary, the receiving terminal regenerates it from the token "**BE**" received from the emitting terminal.

H.4.7.2 Redundancy mechanism to get the redundant session key when necessary

When a "redundant session key" is necessary (the encipherment algorithm needs a key longer than 40 bits), this entity is generated as follows:

The pattern of bits "**Ks**" is repeated as many times as necessary to get the necessary length required for the algorithm. If necessary, a portion of the pattern (beginning with the left-most bit) is appended at the end to fit the correct length.

This principle is illustrated on an example below where the algorithm requires 128 bits (e.g., IDEA).

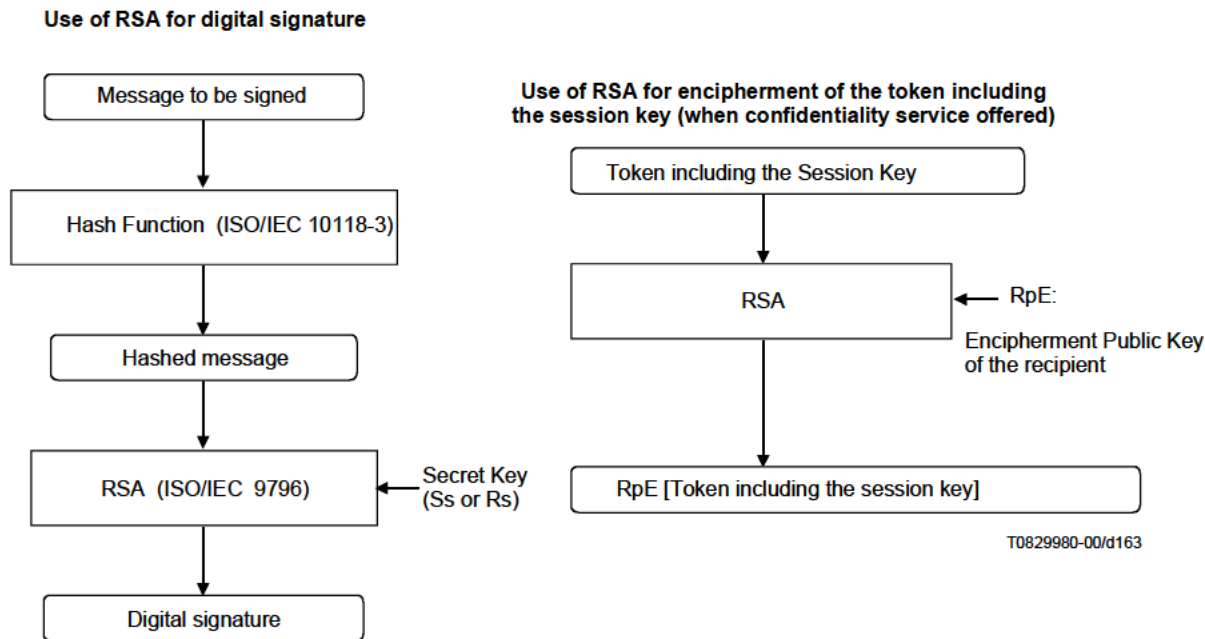


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H.4.8 Use of hash function and RSA algorithm

H.4.8.1 General scheme

See Figure H.1.



NOTE – ISO/IEC 9796 has been designed to RSA-sign a short data, which may be either the message to be signed (if it is short), or the hash code of the message to be signed (if the message is too long), see ISO/IEC 9796.

Figure H.1/T.30

H.4.8.2 Bit order for transmission

Throughout this annex:

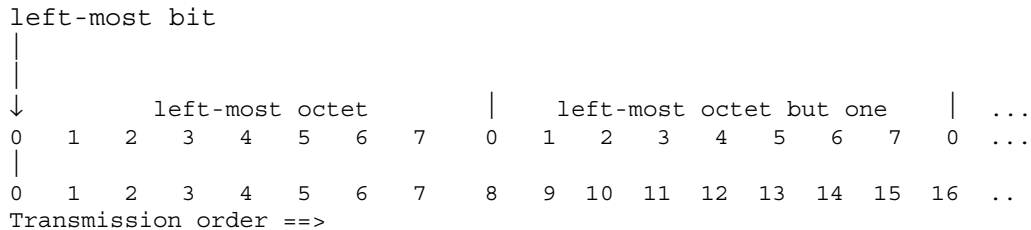
- 1) All the sequence of octets are transmitted such as the left-most octet (as represented in this annex) is the first octet transmitted.
The rule for bit transmission order within each octet is defined below.
- 2) Except for the content of the **FIF** of the DES, DEC, DER and DTR signals which are defined below, for each octet represented in this annex, the order in which the bits are transmitted is from left to right as printed, this is the case, for example, for the FCF codes.
- 3) For the content of the **FIF** of the signals DES, DEC, DER and DTR:
 - a) There is a "General rule" which is the following:
For each octet, the least significant bit is the first transmitted.
When numbered in tables, the least significant bit is numbered "bit No. 0".
For example: the octet "1 0 1 1 0 0 1 1"
and numbered (if numbered):

bit No.	7	6	5	4	3	2	1	0
	1	0	1	1	0	0	1	1

will be transmitted as follows:
Transmission order ==>
1 1 0 0 1 1 0 1

- b) For the cases where the content of the FIF of the existing T.30 signals is encapsulated within a tag encoded structure (see H.6.1.4.7, Encapsulated Frame Supergroup), consistency is maintained with the transmission order of the octets and bits for the FIF as previously defined for these signals (see 5.3 and 5.3.6.2).
- c) Within the FIF of the DES, DEC, DER and DTR, an exception to the general rule is for parameters identified as "binary coded" within Table H.1. For these parameters, the following rule applies:

The first bit transmitted on the line is the left-most bit of the left-most octet:



H.4.8.3 Bit order in the hash and RSA processes

The hash function standards (SHA-1 and MD-5) define a bit string upon which the hashing process is applied and a bit string which is the hash result.

The first bit of these bit strings is the left-most bit (as represented in the figures of this Recommendation).

In this annex, various parameters are specified on which hash function is applied. Some hash results are transmitted on the line. The rules for bit order on the line and bit order for processing in the hash function are the same ones:

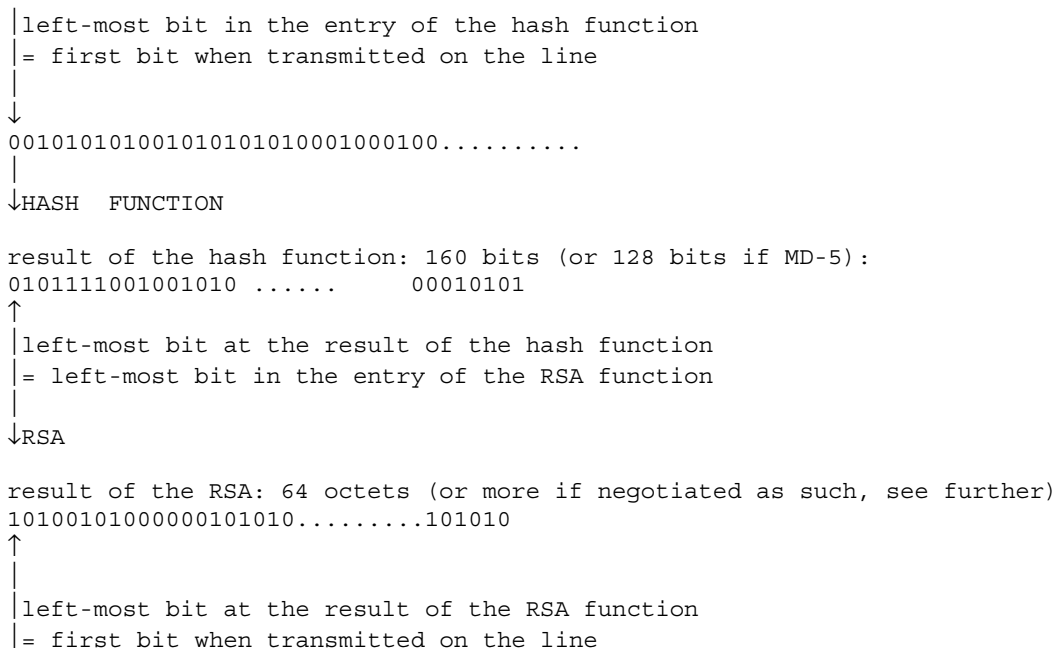
- The first bit passing through the hash function is the left-most bit of the left-most octet.

If the hash function is applied on several concatenated entities, for example $h(a,b,c,...)$, the bit string to be hashed is the bit string [a] immediately followed by the bit string [b], etc.

For the RSA function, the same principle applies:

- The first bit passing through RSA function is the left-most bit of the left-most octet.

The bit order through hash function and RSA is illustrated as follows (the bit strings represented are only for example):



This principle is valid also for the parameters passing directly into the RSA function without hashing (e.g., Token which includes the Session Key "Ks").

If RSA is applied on several concatenated entities, for example (a,b,c, ...), the bit string to be processed by RSA is the bit string [a] immediately followed by the bit string [b], etc.

H.5 Security parameters

Table H.1 defines the various security parameters some of which are exchanged.

For all the security parameters, a basic length is defined. The support of this basic length is mandatory.

In addition, some parameters permit optional longer lengths which can be negotiated in the protocol.

Table H.1 indicates also the type of coding of the parameters (binary, ASCII, ...).

The means to transmit these parameters in the signals DES, DEC, DER and DTR is specified further in this annex.

Table H.1/T.30 – Security parameters

Abbreviation	Description	Basic length	Optional longer lengths	Coding of the field
S	Sender's identity	20 octets	For further study	IA5 coded (Note 1)
Sp	Sender's public key	64 octets	Possible	Binary coded (Note 2)
Ss	Sender's secret key	64 octets	Same as Sp	Binary coded (Note 2)
SpE	Encipherment Sender's public key (for encryption of token containing the session key)	64 octets	Possible	Binary coded (Note 2)
SsE	Encipherment Sender's secret key (for decryption of encrypted token containing the session key)	64 octets	Same as SpE	Binary coded (Note 2)
Sra	Random number created by the sender for authentication of the recipient	8 octets	Possible	Binary coded (Note 2)
Srd	Random number created by the sender for the digital signature	8 octets	Possible	Binary coded (Note 2)
R	Recipient's identity	20 octets	For further study	IA5 coded (Note 1)
Rp	Recipient's public key	64 octets	Possible	Binary coded (Note 2)
Rs	Recipient's secret key	64 octets	Same as Rp	Binary coded (Note 2)
RpE	Encipherment Recipient's public key (for encryption of token containing the session key)	64 octets	Possible	Binary coded (Note 2)

Table H.1/T.30 – Security parameters

Abbreviation	Description	Basic length	Optional longer lengths	Coding of the field
RsE	Encipherment Recipient's secret key (for decryption of encrypted token containing the session key)	64 octets	Same as RpE	Binary coded (Note 2)
Rra	Random number created by the recipient for authentication of the sender	8 octets	Possible	Binary coded (Note 2)
Ks	Session key	40 bits	For further study	Binary coded (Note 2)
BE	BE = RpE[S, Ks] = Sender identity and session key concatenated and encrypted by RpE	64 octets	Same as RpE	Binary coded (Note 2)
UTCd	Date/time chosen by the sender (date/time of the generation/signature of the document)	8 octets	For further study	YY MM DD HH MM SS offset GMT BCD coded (Note 3)
UTCr	Date/time chosen by the recipient (date/time of the confirmation of message receipt)	8 octets	For further study	YY MM DD HH MM SS offset GMT BCD coded (Note 3)
Lm	Length of the document	4 octets	For further study	Corresponds to the number of octets of the whole document transmitted (data octets + pad bits, see H.6.5). BCD coded (Note 4)
h(...)	Hashed result of the entity enclosed in brackets	160 bits or 128 bits depending on the hash-function	For further study	Binary coded (Note 2)
Rs[h(...)]	Hashed result of the entity enclosed in brackets signed by the recipient	64 octets	Same as Rp	Binary coded (Note 2)
Ss[h(...)]	Hashed result of the entity enclosed in brackets signed by the sender	64 octets	Same as Sp	Binary coded (Note 2)
Sia	Indicator in the token used for authentication of the sender	1 octet	No	Octet equal to: "00000000" (Note 5)
Ria	Indicator in the token used for authentication of the recipient	1 octet	No	Octet equal to: "00000001" (Note 5)

Table H.1/T.30 – Security parameters

Abbreviation	Description	Basic length	Optional longer lengths	Coding of the field
Sis	Indicator in the token used for digital signature	1 octet	No	Octet equal to: "00000010" (Note 5)
Ris	Indicator in the token used for confirmation of message receipt	1 octet	No	Octet equal to: "00000011" (Note 5)
document	The document sent during the secure facsimile transmission mode	Variable	Irrelevant	Irrelevant
enc. document	The encrypted document sent during the secure facsimile transmission mode when confidentiality service is invoked. The encryption of the document is made with session key Ks (or the redundant session key if the algorithm requires more bits than Ks to work).	Variable	Irrelevant	Irrelevant

NOTE 1 – The general rule for FIF of DES/DEC/DER/DTR applies: the least significant bit of each octet is the first one transmitted.

NOTE 2 – The rule for transmission of binary coded elements is defined in H.4.8.2.

NOTE 3 – Example: for the 24th March of 1995. 8H25 05s PM. Offset GMT: 3 H:

" 1 9 9 5 0 3 2 4 2 0 2 5 0 5 0 3 "

0001 1001 1001 0101 0000 0011 0010 0100 0010 0000 0010 0101 0000 0101 0000 0011

The general rule for FIF of DES/DEC/DER/DTR applies: the right-most bit of each octet is the first one transmitted.

NOTE 4 – Example: for a document length of 123456 octets:

" 0 0 1 2 3 4 5 6 "

0000 0000 0001 0010 0011 0100 0101 0110

The general rule for FIF of DES/DEC/DER/DTR applies: the right-most bit of each octet is the first one transmitted.

NOTE 5 – The general rule for FIF of DES/DEC/DER/DTR applies: the right-most bit of each octet is the first one transmitted.

H.6 Exchanges of security parameters

The Error Correction Mode (ECM) described in Annex A is required for offering the security services based on RSA.

Some specific security parameters must be transmitted during the facsimile communication at the protocol level (phases B and D of the T.30 protocol). As an option, see further "security page", some security parameters are transmitted at the message level (phase C of T.30 protocol).

H.6.1 Exchange of security parameters at the protocol level

The eight new signals which are used are the following:

- **DER: Digital Extended Request**
This command is sent by the sending terminal. It can set security parameters for the session and also requests further details on the security capabilities of the receiving machine.
- **DES: Digital Extended Signal**
Sent by the receiving device; contains security capabilities of the receiving machine.
- **DEC: Digital Extended Command**
Sent by the sending terminal in response to DES or DTR.
DEC contains all the settings for the current communication.
DEC replaces DCS which is not sent. The information which is normally contained in the FIF of the DCS is contained in the DEC. DEC contains also the various security parameters sent from the emitting terminal to the receiving terminal.
- **DTR: Digital Turnaround Request**
May be sent by the calling terminal in response to DIS or DES; used when polling or turnaround desired.
DTR replaces DTC which is not sent. The information which is normally contained in the FIF of the DTC is contained in the DTR. DTR contains also the various security parameters sent from the receiving terminal to the emitting terminal.
- **DNK: Digital Not Acknowledge**
DER, DES, DEC or DTR are structured in HDLC frames.
DNK indicates that the previous command (DER, DES, DEC or DTR) has not been satisfactorily received and that the frames specified in the FIF of DNK are required to be retransmitted. DNK may be issued either by the emitting terminal or by the receiving terminal (contrary to PPR in Annex A which can only be sent by the receiving terminal).
DNK is also used to reject TCF.
- **TNR: Transmitter Not Ready**
This signal is used to indicate that the transmitter is not yet ready to transmit.
Format:
FCF: X101 0111 (X is the bit defined in 5.3.6.1).
- **TR: Transmitter Ready?**
This signal is used to ask the status of the transmitter.
Format:
FCF: X101 0110 (X is the bit defined in 5.3.6.1).
- **PPS-PSS: Partial Page Signal – Present Signature Signal**
This signal is used to indicate the end of the document and that a digital signature signal follows.
Format:
FCF1: X111 1101 (X is the bit defined in 5.3.6.1)
FCF2: 1111 1000.

The particular coding of DER, DES, DEC, DTR and DNK is detailed further in this annex.

H.6.1.1 Structure of DER, DES, DEC and DTR

H.6.1.1.1 General

DER, DES, DEC and DTR signals are structured in HDLC frames.

The structure of the sequence of frames follows the same rules as that of the multiframe commands already specified in this Recommendation (e.g., NSF-CSI-DIS). These rules are described in 5.3.1, 5.3.3, 5.3.4 and 5.3.5.

H.6.1.1.2 FCF (Facsimile Control Field)

The FCF of the frames is the following:

- DES frames: 0000 0101
- DEC frames: 1100 1001
- DER frames: 1100 1010
- DTR frames: 1000 1000

H.6.1.1.3 FIF (Facsimile Information Field)

The specifications for the FIF of DES, DEC, DER and DTR in the scope of this annex are the following:

The maximum length of the FIF of a frame is 65 octets. If a frame is an intermediate frame (not the last one), its FIF must be 65 octets long, **except when the content of the frame is "FIF of DCS"** (see further). In this latter case, the frame is as long as necessary to contain the FIF octets of the DCS but no more (no pad octet is allowed).

If it is the last frame, the length of the FIF may be less than 65 octets depending on the number of data octets to carry. No pad octet is allowed.

The first octet of the FIF of each frame contains the frame number, then follows the data field. The frame number is an eight bits binary number. The general rules for FIF of DES/DEC/DER/DTR applies: the least significant bit of the frame number (right-most bit) is transmitted the first.

The frame numbered "0" is transmitted first.

Figure H.2 illustrates these principles.

NOTE – The use of frames with FIF longer than 65 octets is for further study.

Preamble	HDLC Address	Control field	Facsimile control field	FIF		FCS	Flag(s)	HDLC address	Control field	Facsimile control field	FIF		FCS	Flag(s)
Flags	1111 1111	1100 X000 X = 0 (non-final frame)	DEC = 1100 1001	Frame number 0000 0000	Data field 64 octets	FCS	At least one flag	1111 1111	1100 X000 X = 1 (final frame)	DEC = 1100 1001	Frame number 0000 0001	Data field ≤ 64 octets	FCS	At least one flag
<p>NOTE 1 – The FCF is transmitted with the left-most bit (as printed in the figure) being the first one transmitted.</p> <p>NOTE 2 – The Frame number is transmitted with the right-most bit (as printed in the figure) being the first one transmitted.</p> <p>In the example, for the frame number of the second frame: 1000 0000 transmission order ==></p> <p>NOTE 3 – The data field of frame "0" may be less than 64 octets if containing the "FIF of DCS".</p>														

Figure H.2/T.30 – Example for a DEC consisting in 2 frames

H.6.1.2 Use and structure of DNK**H.6.1.2.1 Structure of the DNK****Definition**

In the rest of this annex, the terms "signal X" or "X" designate either the signal DER, DES, DEC or DTR.

When some frames of "signal X" are improperly received, DNK permits to request the retransmission of those specific frames.

DNK is also used to reject TCF; see further.

NOTE – When all the frames of an X signal have been received correctly, the normal answer (as specified in this annex) is used as an implicit acknowledgement, except if TCF is to be rejected (DNK is used for this rejection).

DNK consists in one HDLC frame whose structure follows the same rules as for the other T.30 signals (rules are described in 5.3.1, 5.3.3, 5.3.4, 5.3.5).

H.6.1.2.2 FCF of the DNK

The FCF is the following: X101 1001

The definition of the X bit is in 5.3.6.1.

H.6.1.2.3 FIF of the DNK**H.6.1.2.3.1 General**

The FIF consists in an integer number of octets.

For each octet of the FIF of DNK, the left-most bit (as printed) is the first one transmitted. It is numbered bit "0".

The transmission order corresponding to the bit numbering is the following:

Bit No. 01234567 01234567 01234567 ...

transmission order =====>

The first octet of DNK is used to reject TCF when needed (TCF received corrupted).

The further octets are used to request frames received in error.

H.6.1.2.3.2 Request of frames received in error

Beginning with the second octet of the FIF, each bit corresponds to a frame in the previously sent command or response, i.e., the first transmitted bit to the first frame, etc. For frames which are received correctly, the corresponding bit shall be set to "0"; those that are received incorrectly shall have their bit set to "1". Pad bits of value "1" shall be added as required to align on the last octet boundary.

Likewise in ECM mode described in Annex A (but here at the protocol modulation speed), if more than one DNK is transmitted (consecutive to several faulty attempts of transmission of X frames), the bit corresponding to an X frame which has been already correctly received must always be set to "0".

NOTE 1 – It may happen that DNK is resent with a FIF of a different size.

For example: the X signal is received quite improperly and is found to be only 7 frames long whereas it is in fact 9 frames long. In such case, the FIF of the DNK will contain only two octets (the first one which is used for the TCF rejection – see further – and the second one which is sufficient to indicate the frames detected in error). Once the frames of the X signal are re-emitted, the receiving machine finds that the X signal is

9 frames length. If it happens again that some frames are corrupted, a new DNK is sent with 3 octets in its FIF. This example is illustrated below.

NOTE 2 – It must be noticed that the terminal receiving the X signal can locate the last frame with the bit "x" of the HDLC control field (set to "1").

Example with a DEC received improperly (the same principles apply for a corrupted DES, DER or DTR signal)

```

----->
DEC
9 frames
                                <-----
                                DNK with FIF 2 octets long:
                                Bit No.  0123   4567   01234567
                                xxxxx   xxx0   10101111
                                first octet for TCF rejection (see explanation
                                further)
                                frames 0, 2, 4, 5 and 6 improperly received
                                frames 7 and 8 not received
                                (the last bit "1" is only for octet alignment)

```

```

----->
DEC
frames 0, 2, 4, 5, 6, 7
and 8
                                <-----
                                DNK with FIF 3 octets long:
                                Bit No.  0123   4567   01234567  01234567
                                xxxxx   xxx0   10000000  01111111
                                only frame 0 improperly received

```

```

----->
DEC
frame 0
                                <-----
                                frame correctly received
                                normal response = implicit acknowledgement
                                (depends on the context)

```

H.6.1.2.3.3 Maximum time for retransmissions of signal X upon DNK occurrences

Concerning the retransmission of the signal X upon DNK occurrences, the "fail-safe" timer called Tx is defined.

- The fail-safe timer Tx is defined as follows:
Tx = 60 s ± 5 s.
- At the transmitter of the signal X, the timer Tx is started at the time of the first DNK recognition and is stopped at the time of the normal response recognition or FNV.
- If the timer Tx has expired, the transmitter of the signal X sends a DCN command for call release.

H.6.1.2.3.4 Specific rejection by DNK

The left-most bit of the first octet of the FIF of DNK (numbered "No. 0" in Table H.2) is used for rejection of TCF (TCF corrupted); this is the equivalent role of FTT in normal T.30.

The TCF rejection defined in Table H.2 cannot be combined with the indication of frames X received in error as defined in H.6.1.2.3.2.

The process of rejection is sequential as follows:

- 1) First all the corrupted frames of the DEC (or DES, or DER or DTR) are requested by the DNK. The bit No. 7 and bit No. 0 of the first DNK octet are set to "0" (bit No. 0 meaningless at this stage).
- 2) Once all the frames have been corrected, the content of the DEC (or DES, or DER or DTR) may be rejected by FNV if necessary (see further);
or if the content of DEC is correct and in case of the TCF following the DEC is corrupted, the TCF is rejected by the first octet of DNK.

Table H.2/T.30 – "Specific rejection by first octet of FIF of DNK"

Specific rejection	Coding of the first octet of FIF of DNK																		
TCF corrupted (equivalent of FTT in normal mode)	<table><tr><td>Bit No.</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td></td><td>1</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td></tr></table>	Bit No.	0	1	2	3	4	5	6	7		1	x	x	x	x	x	x	x
Bit No.	0	1	2	3	4	5	6	7											
	1	x	x	x	x	x	x	x											
Bits 1 to 6 are reserved for future use.	<table><tr><td>Bit No.</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td></td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td></tr></table>	Bit No.	0	1	2	3	4	5	6	7		x	x	x	x	x	x	x	x
Bit No.	0	1	2	3	4	5	6	7											
	x	x	x	x	x	x	x	x											
The bit No. 7 must be set to "1" if all the frames have been correctly received and DNK is sent only for TCF rejection. If bit No. 7 is set to "1", the octets after the first one are not sent.	<table><tr><td>Bit No.</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td></td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>1</td></tr></table>	Bit No.	0	1	2	3	4	5	6	7		x	x	x	x	x	x	x	1
Bit No.	0	1	2	3	4	5	6	7											
	x	x	x	x	x	x	x	1											

Precisions:

- As specified in this annex, the bits of the FIF of DCS are placed in the first HDLC frame of the DEC.
- As for the other frames, frame No. 0 of a DEC containing the FIF of DCS is re-emitted only when requested by the DNK (if this frame has been improperly received). There is an exception to this rule when TCF is rejected: in such a case, frame No. 0 must always be sent along with the TCF, see example further.

Example with a DEC followed by TCF

----->
DEC 3 frames
----->

TCF

<-----

DNK with FIF 2 octets long:

Bit No.	01234567	01234567
	00000000	01011111

frame 1 improperly received
frames 0 and 2 correctly received

----->
DEC 1 frame:
frame 1
----->

TCF

<-----

DNK with FIF 1 octet long:

Bit No.	01234567
	10000001

frame 1 correctly received
TCF rejection

----->
DEC 1 frame:
frame 0 (contains FIF of
DCS)
----->

TCF

<-----

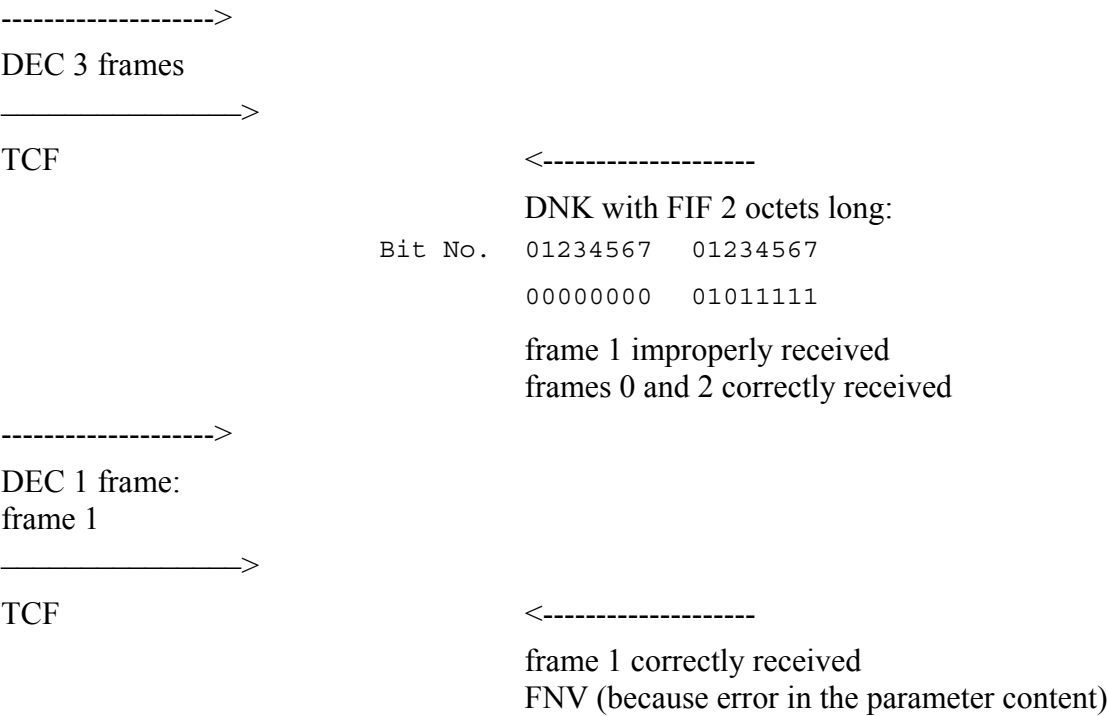
frame 0 correctly received and TCF correct
normal response = implicit acknowledgement
(depends on the context)

H.6.1.3 Precisions for the use of FNV in Annex H

FNV defined in 5.3.6.2.13 is used only after the following condition is satisfied:

- There is no pending frame of a signal X to be corrected.

Example



H.6.1.4 Data encoding within the FIFs of the DER, DES, DEC and DTR

H.6.1.4.1 Supergroups and Groups

The sequence of the Facsimile Information Fields of DER, DES, DEC and DTR signals is structured in Groups and Supergroups.

Groups are collections of similar or related terminal or session attributes that will often need to be negotiated at the same time.

Supergroups provide an additional hierarchy so that Groups of related attributes may be kept together.

The general sequence of Supergroups and Groups which can be presented in the sequence of Facsimile Information Fields of DER, DES, DEC and DTR signals is as follows:

SG1[G1..G2..G3...]SG2[G1..G2..G3...]...SGn[G1..G2..G3...]

where SG indicates Supergroups and G indicates Groups.

Supergroups are identified by Supergroup Tags, called also in this annex "super-tags".

Supergroups contain Groups identified by Group Tags, called also in this annex simply as "tags".

A super-tag is followed by the length of the Supergroup it identifies and then by the sequence of the Groups of the Supergroup.

For each Group, the tag which identifies the Group is followed by the length of the Group and then by the content of the Group.

Notations

- Within this annex, the content of the Group is called "parameter".
- The length of the Group is called "length of the parameter value".
- The content of the Group is called "value of the parameter".

H.6.1.4.2 Tag Assignment

- 1) The super-tags are eight bits long.
An initial tag value of Hex FF indicates an extension of 8 additional bits (may be used in future versions of this annex).
- 2) The tags are eight bits long. The extension principle applied is the same as used for super-tags.

H.6.1.4.3 Length of Supergroups – Length of Groups

The count is in units of octets. The first octet after the super-tag or tag contains the number of octets that follow. If the initial count octet is 0, then the two octets following the count octet indicate the number of octets to follow.

Examples: for a 20-octet long parameter value, the length octet will be: "00010100".

Examples: for a 257-octet long parameter value, the length octets will be:
"0000 0000 0000 0001 0000 0001".

The general rule for FIF of DES/DEC/DER/DTR applies: the right-most bit of each octet as printed (least significant bit) is the first one transmitted.

H.6.1.4.4 Encoding rules

A formal description of the encoding rules for encoding the Facsimile Information Fields of DER, DES, DEC and DTR signals follows in Backus-Naur Form (BNF):

Encoding rules for facsimile tag encoding syntax

<bit>	::=	<0> <1>
<octet>	::=	<bit><bit><bit><bit><bit><bit><bit><bit>
<8_bit_tag>	::=	<octet>
<extend_octet>	::=	{<1><1><1><1><1><1><1><1>}
<tag>	::=	<8_bit_tag> <extend_octet> <8_bit_tag><8_bit_tag>
<parameter_value>	::=	<octet>{<octet>}
<count_extend_octet>	::=	<0><0><0><0><0><0><0><0>
<parameter_length>	::=	<octet> <count_extend_octet><octet><octet>
<Group>	::=	<tag><parameter_length><parameter_value>
<frame_number>	::=	<octet>
<Supergroup_tag>	::=	<tag>
<Supergroup_length>	::=	<parameter_length>
<Supergroup>	::=	<Supergroup_tag><Supergroup_length><Group>{<Group>}
<Tag_Encoded_Data>	::=	<Supergroup>{<Supergroup>}
<FIF>	::=	<frame_number><Tag_Encoded_Data>

NOTE – The Tag_Encoded_Data may extend over multiple frames; see H.6.1.4.6.

H.6.1.4.5 Description of Backus-Naur Form

The following provides a description of the Backus-Naur style syntax which is used in H.6.1.4.4.

Symbol Description of use

- | | |
|---------|--|
| literal | A token (or component) is noted by a literal. |
| ::= | This is the production assignment operator. |
| | This symbol is used to separate alternative tokens or groups of tokens. |
| <> | A non-terminal token is noted by a literal enclosed by the "<" and ">" characters. |

[] An optional token or group of tokens is enclosed by the "[" and "]" characters.

{ } A group of tokens enclosed in "{" and "}" may be repeated 0, 1 or more times.

H.6.1.4.6 Relationship between FIFs encoding and the structure in HDLC frames

The formatting in super-tags, tags and parameters as described above is independent of the structure in HDLC frames described in H.6.1.1. The series of octets which constitutes the sequence of super-tags, tags and corresponding parameters is orderly inserted in the FIF of the HDLC frames: filling firstly the FIF of the first frame (frame "0"), then filling the FIF of the second frame (frame "1"), etc.

H.6.1.4.7 Encapsulated Frame Supergroup

A Supergroup is created which gathers all the Groups which contain the FIF of the following usual T.30 frames: DCS, TSI, SUB, SID, DTC, CIG, SEP, PWD, PSA.

This Supergroup is called "Encapsulated Frame Supergroup".

The super-tag which identifies this Supergroup is: "0000 0001".

H.6.1.4.8 The two Supergroups for security

Two Supergroups are created for security:

- one for the registration mode;
- another for the secure transmission mode.

H.6.1.4.9 List of the super-tags

See Table H.3.

Table H.3/T.30 – List of the super-tags

Code of the super-tag	Name of the super-tag	Description
0000 0001	Encapsulated Frame (Abbreviation "E-F")	This super-tag is that of the Encapsulated Frame Supergroup which gathers all the Groups which contain the FIF of usual T.30 frames.
0000 0010	Registration mode	This super-tag is that of the Supergroup which gathers all the Groups transmitted in the registration mode.
0000 0011	Secure transmission mode	This super-tag is that of the Supergroup which gathers all the Groups transmitted in the secure facsimile communication.

H.6.1.4.10 List of the tags within the Encapsulated Frame Supergroup

See Table H.4.

Table H.4/T.30 – List of the tags within the Encapsulated Frame Supergroup

Code of the tag	Name of the tag	Description
1000 0011	FIF of DCS	This tag delimits the zone where the bits corresponding to the FIF of the DCS are placed (bits of Table 2).
0100 0011	FIF of TSI	This tag delimits the zone where the bits corresponding to the FIF of the TSI are placed (when used).
1100 0011	FIF of SUB	This tag delimits the zone where the bits corresponding to the FIF of the SUB are placed (when used).

Table H.4/T.30 – List of the tags within the Encapsulated Frame Supergroup

Code of the tag	Name of the tag	Description
1010 0011	FIF of SID	This tag delimits the zone where the bits corresponding to the FIF of the SID are placed (when used).
1000 0001	FIF of DTC	This tag delimits the zone where the bits corresponding to the FIF of the DTC are placed (when used).
0100 0001	FIF of CIG	This tag delimits the zone where the bits corresponding to the FIF of the CIG are placed (when used).
1100 0001	FIF of PWD	This tag delimits the zone where the bits corresponding to the FIF of the PWD are placed (when used).
1010 0001	FIF of SEP	This tag delimits the zone where the bits corresponding to the FIF of the SEP are placed (when used).
0110 0001	FIF of PSA	This tag delimits the zone where the bits corresponding to the FIF of the PSA are placed (when used).

H.6.1.4.11 List of tags for security features

The following tags can be introduced by:

- the security super-tags "Registration mode"; or
- "Secure transmission mode".

Some of the parameters are only used at the message level ("security page", see further); they are marked by a star character "*" in Table H.5.

Table H.5/T.30 – List of tags for security features

Code of tag		Name of the tag	Description
0001 0001		S	Sender's identity
0001 0010		Sp	Sender's public key
0001 0011		Ss	Sender's secret key
0001 0100		SpE	Encipherment Sender's public key
0001 0101		SsE	Encipherment Sender's secret key
0001 0110		R	Recipient's identity
0001 0111		Rp	Recipient's public key
0001 1000		Rs	Recipient's secret key
0001 1001		RpE	Encipherment Recipient's public key
0001 1010		RsE	Encipherment Recipient's secret key
0001 1011		Sra Srd Rra	Random number created respectively – created by the sender authentication of the recipient – created by the sender for the digital signature – created by the recipient for the authentication of the sender
0001 1100		BE = RpE[S, Ks]	Sender identity and Session key encrypted by RpE
0001 1101		UTCd	Date/time chosen by the sender (date/time of the generation/signature of the document)

Table H.5/T.30 – List of tags for security features

Code of tag		Name of the tag	Description
0001 1110		UTCr	Date/time chosen by the recipient (date/time of the confirmation of message receipt)
0001 1111		Lm	Length of the document
0010 0000		Token 2 = Ss[h(Sra, Rra, R), Sia]	Token used for authentication of the sender when the [Message confidentiality + Session Key establishment] service has not been invoked
0010 0001		Token 2-enc. = Ss[h(Sra, Rra, R, BE), Sia]	Token used for authentication of the sender when the [Message confidentiality + Session Key establishment] service has been invoked
0010 0010		Token 3 = Rs[h(Rra, Sra, S), Ria]	Token used for authentication of the recipient
0010 0011		Token 4 = Ss[h(Srd, UTCd, Lm, R, h(document)), Sis]	Token used for providing the message integrity when the [Message confidentiality + Session Key establishment] has not been invoked
0010 0100		Token 4-enc. = Ss[h(Srd, UTCd, Lm, R, BE, h(enc.document)), Sis]	Token used for providing the message integrity when the [Message confidentiality + Session Key establishment] has been invoked
0010 0101		Token 5 = Rs[h(Srd, UTCr, Lm, S, h(document)), Ris]	Token used for confirmation of message receipt when the [Message confidentiality + Session Key establishment] service has not been invoked
0010 0110		Token 5-enc. = Rs[h(Srd, UTCr, Lm, S, BE, h(enc.document)), Ris]	Token used for confirmation of message receipt when the [Message confidentiality + Session Key establishment] service has been invoked
0010 0111		Security services	Security services
0010 1000		Security mechanisms	Key management mechanisms, hash functions, encipherment algorithms
0010 1001		Optional lengths capability	Optional lengths capability
0010 1010		Request of security capabilities	By use of this tag (and the relevant parameter), the terminal requests the remote terminal for the indication of its security capabilities
0010 1011		Acknowledgement	Acknowledgement used in registration mode
0010 1100	*	Security-page-indicator	Indicates the page where the security page is
0010 1101	*	Security-Page-Type-Identification	Indicates the version number of the security page. In future versions of this annex, other types of security pages may be allowed, there will be given other version numbers
0010 1110	*	Certification path	Certification path
0010 1111		Unstandardized features	Unstandardized features
NOTE – The optional tag "Unstandardized features" may be used on the basis of recognition of identification codes in the NSF. The information contained in the initial octets of the "Unstandardized features" parameter value shall be consistent with the identification rules defined in 5.3.6.2.7 (Non-standard capabilities NSF, NSC, NSS).			

H.6.1.4.12 Order of super-tags and tags

In the sequence of super-tags, tags and parameters values, the order is the following:

- encapsulated Frame Supergroup is transmitted before the security Supergroups;
- within each Supergroup, the order of tags is unfixed, except that:
 - within the Encapsulated Frame Supergroup, the Tag **"FIF of DCS" must be the first transmitted** (if present); that is for easiness in case of re-emission after TCF rejected [the data field of the first DEC frame which contains (and only contains) "FIF of DCS" **is shorter than 64 octets**];
- within each sequence of tags (and parameters values) introduced by security super-tags, the order of tags is unfixed.

H.6.1.4.13 Coding of the "Security services" parameter

Table H.6 gives the coding of the parameter value which follows the tag "Security services" and the relevant length octet.

The length octet is "0000 0001" (the parameter is only one octet long). In future versions of this annex, the parameter may be longer.

Table H.6/T.30 – "Security services" parameter

Security services	Status	Coding of the field
Mutual authentication	Mandatory	Bit No. 7 6 5 4 3 2 1 0 x x x x x x x x No necessity of bit assignment because mandatory
Security service which includes: <ul style="list-style-type: none"> • Mutual authentication • Message integrity • Confirmation of message receipt 	Optional	Bit No. 7 6 5 4 3 2 1 0 x x x x x x x 1
Security service which includes: <ul style="list-style-type: none"> • Mutual authentication • Message confidentiality (encryption) • Session Key establishment 	Optional	Bit No. 7 6 5 4 3 2 1 0 x x x x x x 1 x
Security service which includes: <ul style="list-style-type: none"> • Mutual authentication • Message integrity • Confirmation of message receipt • Message confidentiality (encryption) • Session Key establishment 	Optional	Bit No. 7 6 5 4 3 2 1 0 x x x x x x 1 1
NOTE 1 – Registration service does not need bit allocation because it is mandatory. NOTE 2 – If no optional service, the bit allocation is "0000 0000". NOTE 3 – If the security service "Mutual authentication" is only selected by the sender (for Secure facsimile transmission mode), the "Security services" parameter is not sent (because "Mutual authentication" is the basic service).		

The four sets of services as described in Table H.6 can be depicted in Table H.7 where 4 profiles of services can be identified:

Table H.7/T.30 – Security profiles in Annex H

Security services	Service profiles			
	1	2	3	4
Mutual authentication	X	X	X	X
• Message integrity • Confirmation of message receipt		X		X
• Message confidentiality (encryption) • Session Key establishment			X	X

H.6.1.4.14 Coding of the "Security mechanisms" parameter

Table H.8 gives the coding of the parameter value which follows the tag "Security mechanisms" and the relevant length octet.

Table H.8/T.30 – "Security mechanisms" parameter

Mechanisms	Status	Coding of the field
Version of the security system	Mandatory	Bit No. 7 6 5 4 3 2 1 0 x x x x x x 0 0 (Note)
SHA-1 (hash function)	Optional	Bit No. 7 6 5 4 3 2 1 0 x x x x x 1 x x
MD-5 (hash function)	Optional	Bit No. 7 6 5 4 3 2 1 0 x x x x 1 x x x
Security page	Optional	Bit No. 7 6 5 4 3 2 1 0 x x x 1 x x x x
SAFER K-64 (encipherment algorithm)	Optional	Bit No. 7 6 5 4 3 2 1 0 x x 1 x x x x x
FEAL-32 (encipherment algorithm)	Optional	Bit No. 7 6 5 4 3 2 1 0 x 1 x x x x x x
RC5 (encipherment algorithm)	Optional	Bit No. 7 6 5 4 3 2 1 0 1 x x x x x x x
Second octet	Optional	
IDEA (encipherment algorithm)	Optional	Bit No. 7 6 5 4 3 2 1 0 x x x x x x x 1
HFX40	Optional	Bit No. 7 6 5 4 3 2 1 0 x x x x x x 1 x
DSA (key management)	Optional	Bit No. 7 6 5 4 3 2 1 0 x x x x x 1 x x
Bits 3 to 7 reserved for future use (set to "0")		Bit No. 7 6 5 4 3 2 1 0 x x x x x x x x
...	Optional	Bit No. 7 6 5 4 3 2 1 0 x x x x x x x x
Last octet	Optional	Bit No. 7 6 5 4 3 2 1 0 x x x x x x x x

Table H.8/T.30 – "Security mechanisms" parameter

NOTE – As new versions of Annex H security system are introduced, backward compatibility should be maintained.

The second octet is optional.

The octets from the third one to the last one are also optional octets. They may be absent.

Each of these octets codes an optional encipherment algorithm available in the receiving terminal. The octet is the number of one encipherment algorithm registered in the entry index of Attachment 2 of ISO/IEC 9979 (Procedure for registering cryptographic algorithms); this number is binary coded (e.g., "0000 0000" for the entry No. 00).

When the emitting terminal selects the mechanisms, the "Security mechanisms" parameter is usually only one or two octets long. The third octet is only necessary in case of selection of an encipherment algorithm registered in ISO/IEC 9979 and which is not SAFER K-64, nor FEAL-32, nor RC5, nor IDEA, nor HFX40 (the third octet indicates the algorithm selected).

The length octet depends on the number of optional encipherment algorithms which are indicated (see Table H.8).

For the negotiation:

- if requested by the emitting terminal, the receiving terminal indicates the security mechanisms it supports in sending the "Security mechanisms" parameter;
- the emitting terminal selects the security mechanisms for the session: one hash function, one (or none) encipherment algorithm.

In the "security page" (see further), the "Security mechanisms" parameter indicates also the security mechanisms which have been selected for the session.

H.6.1.4.15 Coding of the "Optional lengths capability" parameter

H.6.1.4.15.1 Principle

For indication of the optional lengths capabilities, the "Optional lengths capability" tag, length octet and corresponding parameter value are sent.

H.6.1.4.15.2 Coding of the parameter "Optional lengths capability"

For coding the parameter, the following principles are defined:

- Offsets permit to indicate the maximal lengths which can be processed by the terminal. These offsets are binary coded on 4 bits or 8 bits depending on the parameter which is concerned.
- These offsets are used on a specific order:

7	6	5	4	3	2	1	0	Octets
offset a				offset b				0
offset c				reserved				1

First, the octet No. 0 which contains:

- firstly the offset "a" (4 bits) for indication of the maximum length of Public and Secret keys accepted;
- then the offset "b" (4 bits) for indication of the length of the Random numbers accepted (Sra, Srd, Rra).

Then, the octet No. 1 (optional) which contains:

- the offset "c" (4 bits) for indication of the maximum length of Encipherment Public and Encipherment Secret keys accepted.

Therefore, the length octet of the "Optional lengths capability" parameter is either "0000 0001" (one octet long if the [Message confidentiality + Session Key establishment] service is not offered) or "0000 0010" (two octets if the [Message confidentiality + Session Key establishment] service is offered). In future versions of this annex, the parameter may be longer.

H.6.1.4.15.3 Rules for using the offsets

Maximum length (in octets) of the Public and Secret keys =

$$64 \text{ (basic length)} + ([\text{offset a}] \times 16) \text{ octets}$$
$$\text{with } 0 \leq \text{offset a} \leq 4 \qquad \text{octets}$$

The terminal must be capable to handle all the lengths between the basic length and the maximum length, by 16-octet increments.

Maximum length (in octets) of Random numbers =

$$8 \text{ (basic length)} + [\text{offset b}] \text{ octets}$$
$$\text{with } 0 \leq \text{offset b} \leq 8 \qquad \text{octets}$$

The terminal must be capable to handle all the lengths between the basic length and the maximum length.

Maximum length (in octets) of the Encipherment Public and Encipherment Secret keys =

$$64 \text{ (basic length)} + ([\text{offset c}] \times 16) \text{ octets}$$
$$\text{with } 0 \leq \text{offset c} \leq 4 \qquad \text{octets}$$

The terminal must be capable to handle all the lengths between the basic length and the maximum length, by 16-octet increments.

H.6.1.4.15.4 Examples

Example 1

7	6	5	4	3	2	1	0	Octets
0	0	0	1	0	0	0	0	0
0	0	0	1	0	0	0	0	1

In this example:

- Maximum length of Public and Secret key = $64 + 16 \times 1 = 80$ octets
- Maximum length of Random numbers = $8 + 0 = 8$ octets (no optional lengths supported)
- Maximum length of Encipherment Public and Encipherment Secret key = $64 + 16 \times 1 = 80$ octets

Example 2

7	6	5	4	3	2	1	0	Octet
0	0	0	0	0	0	0	0	0

In this example, the terminal indicates the only basic capabilities.

H.6.1.4.16 Coding of the "Request of security capabilities" parameter

By use of this tag (and the relevant parameter), the terminal requests the remote terminal for the indication of its security capabilities. See Table H.9.

The length octet is "0000 0001" (the parameter is only one octet long). In future versions of this annex, the parameter may be longer.

Table H.9/T.30 – "Request of security capabilities" parameter

Capabilities indication requested	Status	Coding of the field							
Request of the "Security services"	Optional	Bit No.	7	6	5	4	3	2	1 0
			x	x	x	x	x	x	x 1
Request of the "Security mechanisms"	Optional	Bit No.	7	6	5	4	3	2	1 0
			x	x	x	x	x	x	1 x
Request of "Optional lengths capability"	Optional	Bit No.	7	6	5	4	3	2	1 0
			x	x	x	x	x	1	x x
Request of "Unstandardized features"	Optional	Bit No.	7	6	5	4	3	2	1 0
			x	x	x	x	1	x	x x
NOTE – If the "Request of security capabilities" parameter is used, at least one bit must be set to "1" (otherwise, there is no purpose of using this parameter for the session).									

H.6.2 Registration mode

H.6.2.1 Scheme

The scheme is described in Figure H.3. It comprises of two steps:

- *Step one*
[The identity of the sender and its public key are hashed by the sending terminal.
The identity of the recipient and its public key are hashed by the receiving terminal].
OR/AND
[(The identity of the sender and its encipherment public key are hashed by the sending terminal).
OR/AND
(The identity of the recipient and its encipherment public key is hashed by the receiving terminal)].
These hash results are exchanged out-of-band (direct hand-to-hand, by mail, by phone, etc.) and stored in the terminals.
- *Step two*
Exchange, by T.30 protocol means, of the identities and the public keys between the two parties. Storage in the terminals.

The order of the two steps is not fixed.

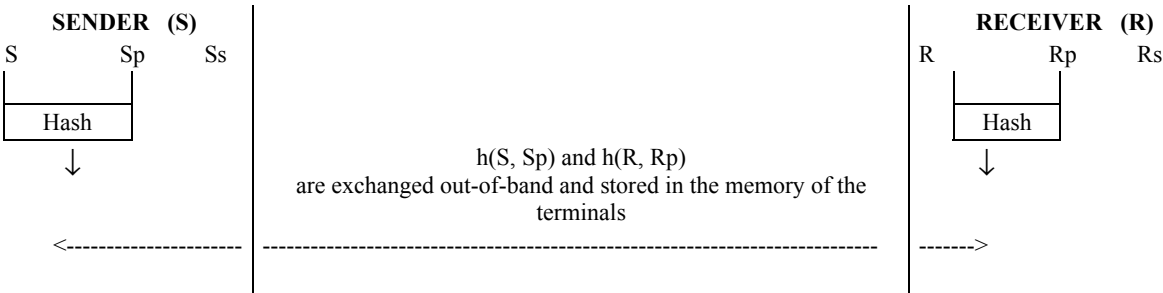
The validity of the identity and the public key(s) of the other party is assessed in comparing the hash result exchanged out-of-band with the hash result of the identity and public key(s) received through the protocol.

Once validated, these values [identity and public key(s) of the remote party] are stored in the terminals and are used for the further secure facsimile communications with this party.

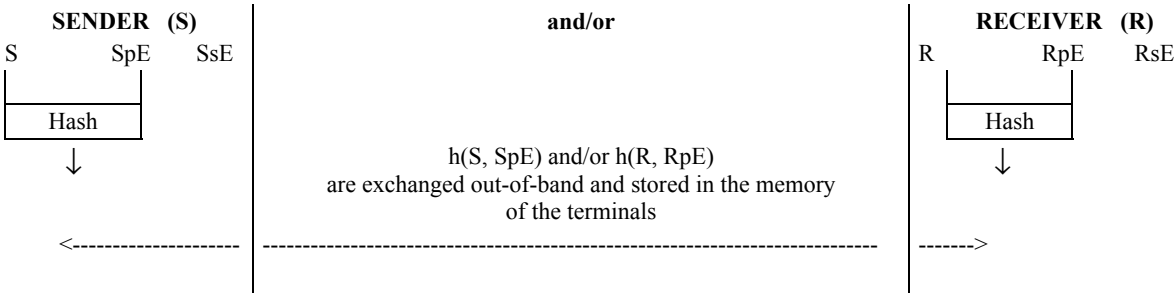
The registration of either the public keys or the encipherment public keys or both is fixed by agreement between the users of the two terminals. For the encipherment public keys, the registration may concern only one user or both.

Settings of the terminals for the relevant registrations is a local matter.

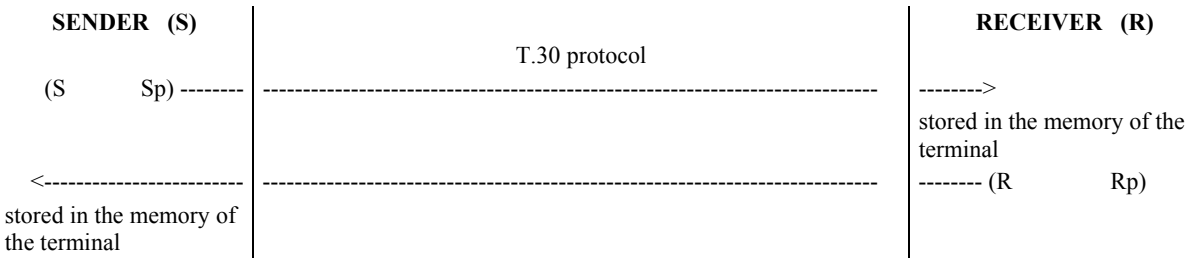
Exchange of the hash results out-of-band and storage in the terminals.



Instead of or in addition to [S, Sp, h(S, Sp)] and [R, Rp, h(R, Rp)], the above operation may concern [S, SpE, h(S, SpE)] and/or [R, RpE, h(R, RpE)]:



T.30 call establishment, exchange of identities and public keys through T.30 protocol.



Instead of or in addition to [S, Sp] and [R, Rp], the above operation may concern [S, SpE] and/or [R, RpE]:

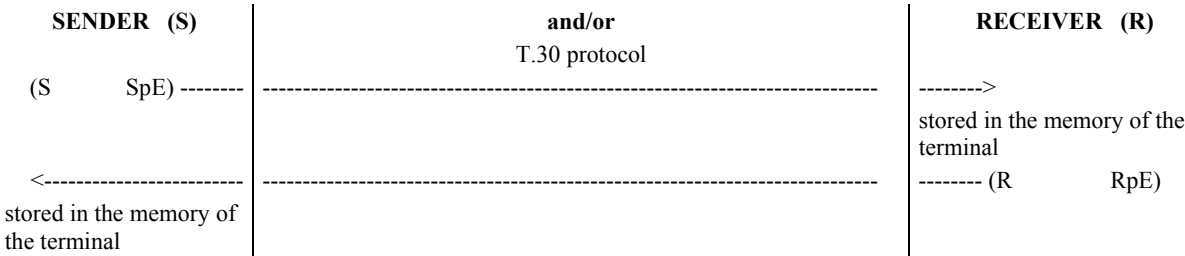


Figure H.3/T.30 – Scheme of registration mode

H.6.2.2 Use of DER, DES and DEC for registration mode

In the second step of the registration mode, the signals DER, DES, DEC are used as in Figure H.4.

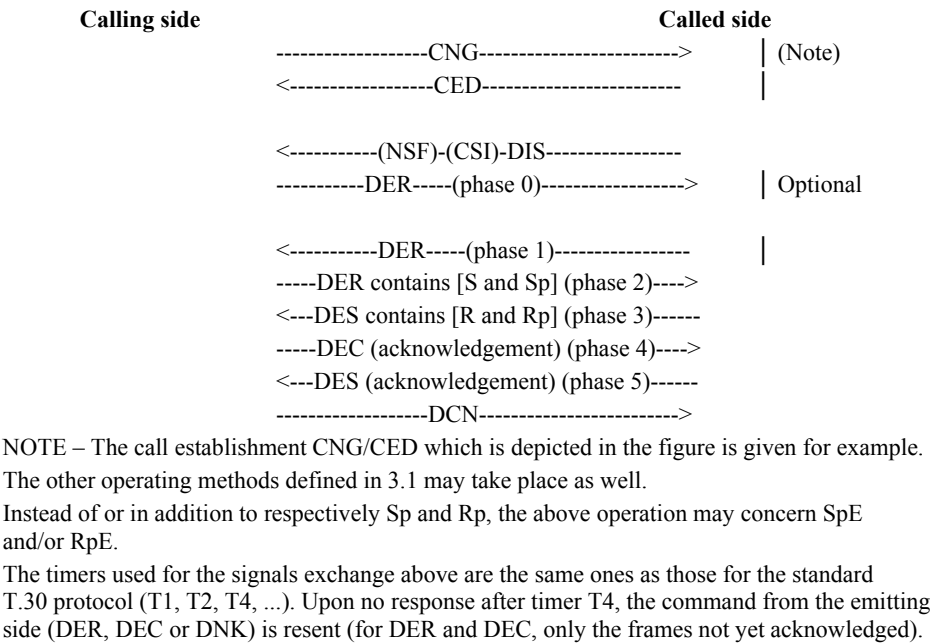


Figure H.4/T.30 – Signals exchange for registration mode

H.6.2.3 Bits allocation in the DIS

The bits allocation in the FIF of the DIS to indicate the security capabilities based on the RSA algorithm is given in Table 2. Bit No. 82 is used.

H.6.2.4 Format of the Facsimile Information Fields of DER, DES and DEC for registration mode

Convention

In the figures of this annex, when the tag (and the relevant length octet and parameter value) is represented in grey boxes, its use is optional.

When represented in white boxes, its use is mandatory.

H.6.2.4.1 Phase 0 OPTIONAL

If the calling side does not wish to use optional capabilities, phase 0 is optional; registration mode is carried on with the basic features (Sp, Rp are 64 octets long, no exchange of Encipherment public keys).

The sequence contained in the FIF(s) of the DER is:

Super-tag "E-F"	Length of Supergroup	Tag "FIF of SUB"	Length + Content of "FIF of SUB"	Tag "FIF of SID"	Length + Content of "FIF of SID"	Tag "FIF of TSI"	Length + Content of "FIF of TSI"
--------------------	-------------------------	------------------------	--	------------------------	--	------------------------	--

Super-tag "Registration mode"	Length of Supergroup	Tag "Request of security capabilities"	Length + Content of "Request of security capabilities"
-------------------------------------	-------------------------	--	--

Tag "Unstandardized features"	Length + Content of "Unstandardized features"
-------------------------------------	--

Conventions

For simplicity, the representations of sequences [super-tags, tags, length octets and parameters values] do not describe the internal HDLC structure of the signal (preamble, flags, address, control, ..., FCS, flags).

A sequence may be represented by boxes on several rows. This is only for commodity; the sequence is continuous.

These remarks apply for the rest of this annex where such representations are given.

H.6.2.4.2 Phase 1 OPTIONAL

Phase 1 takes place only if phase 0 exists.

The sequence contained in the FIF(s) of the DES is:

Super-tag "Registration mode"	Length of Supergroup	Tag "Security services"	Length + Content of "Security services"
-------------------------------------	-------------------------	-------------------------------	---

Tag "Security mechanisms"	Length + Content of "Security mechanisms"	Tag "Optional lengths capability"	Length + Content of "Optional lengths capability"	Tag "Unstandardized features"	Length + Content of "Unstandardized features"
---------------------------------	--	--	---	-------------------------------------	--

The optional [tag, length octet and parameter value] groups are present depending on the requests in phase 0 (bits in the "Request of security capabilities" parameter).

H.6.2.4.3 Phase 2

The sequence contained in the FIF(s) of the DER is:

Super-tag "E-F"	Length of Supergroup	Tag "FIF of SUB"	Length + Content of "FIF of SUB"	Tag "FIF of SID"	Length + Content of "FIF of SID"	Tag "FIF of TSI"	Length + Content of "FIF of TSI"
--------------------	-------------------------	------------------------	--	------------------------	--	------------------------	--

Super-tag "Registration mode"	Length of Supergroup	Tag "S"	Length + Content of "S"	Tag "Sp"	Length + Content of "Sp"
-------------------------------------	-------------------------	------------	----------------------------	-------------	-----------------------------

Tag "SpE"	Length octet + Content of "SpE"	Tag "Security mechanisms"	Length octet + Content of "Security mechanisms"	Tag "Unstandardized features"	Length + Content of "Unstandardized features"
--------------	---------------------------------------	---------------------------------	--	-------------------------------------	--

Above is an example of registration of Sp and SpE at the same time.

It is also possible that only Sp or SpE is registered. S is present in all cases.

Settings of the terminals for the relevant registrations is a local matter.

The "Security mechanisms" parameter is mandatory because it indicates the selected hash function and/or the selected encipherment algorithm (in case of SpE and/or RpE exchanged).

H.6.2.4.4 Phase 3

The sequence contained in the FIF(s) of the DES is:

Super-tag "Registration mode"	Length of Supergroup	Tag "R"	Length + Content of "R"	Tag "Rp"	Length + Content of "Rp"
-------------------------------------	-------------------------	------------	-------------------------------	-------------	--------------------------------

Tag "RpE"	Length + Content of "RpE"
--------------	---------------------------------

Above is an example of registration of Rp and RpE at the same time.

It is also possible that only Rp or RpE is registered. R is present in all cases.

Settings of the terminals for the relevant registrations is local matter.

If the called terminal can find that the S and Sp parameters (and/or [S, SpE]) do not conform with the hash value stored (in case of exchange of hash values out-of-band already made, see H.6.2.1), it can reject them by the signal FNV.

The reason of the error in FNV is "Registration error for public key" or "Registration error for encipherment public key"; see Table H.10.

The use of FNV for such an error indication is explained in H.6.7.

H.6.2.4.5 Phase 4

The sequence contained in the FIF of the DEC is:

Super-tag "Registration mode"	Length of Supergroup	Tag "Acknowledgement"	Length octet "0000 0000"
-------------------------------------	-------------------------	--------------------------	-----------------------------

If the calling terminal can find that the R and Rp parameters (and/or [R, RpE]) do not conform with the hash value stored (in case of exchange of hash values out-of-band already made, see H.6.2.1), it can reject them by the signal FNV.

The reason of the error in FNV is "Registration error for public key" or "Registration error for encipherment public key", see Table H.10.

The use of FNV for such an error indication is explained in H.6.7.

H.6.2.4.6 Phase 5

The sequence contained in the FIF of the DES is:

Super-tag "Registration mode"	Length of Supergroup	Tag "Acknowledgement"	Length octet "0000 0000"
-------------------------------------	-------------------------	--------------------------	-----------------------------

H.6.3 Secure facsimile transmission mode

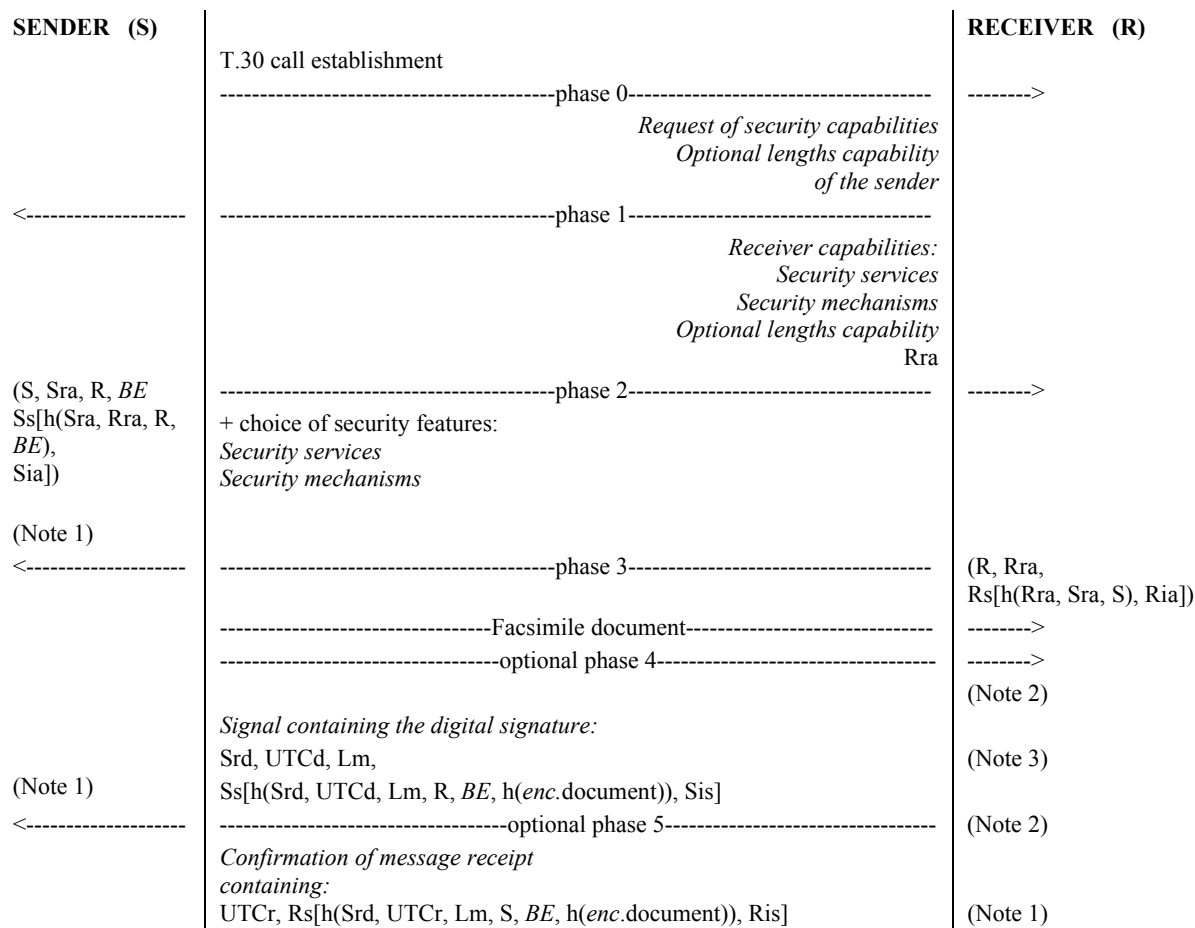
This mode consists in the transmission of the facsimile document with security features.

Security parameters are transmitted within protocol elements (phases B and D of the T.30 protocol).

As an option, some security parameters are transmitted at the message level (at the message speed, phase C of T.30 protocol): within a special page called **"the security page"**.

H.6.3.1 Scheme

See Figure H.5.



Italicized characters indicate optional features.

NOTE 1 – BE (= RpE[S, Ks]) exists in the various tokens only if the service [Message confidentiality + Session Key establishment] has been negotiated between the two parties (with the "Security services" parameter).

NOTE 2 – Phases 4 and 5 exist only if the service [Message integrity + Confirmation of message receipt] has been negotiated between the two parties (with the "Security services" parameter).

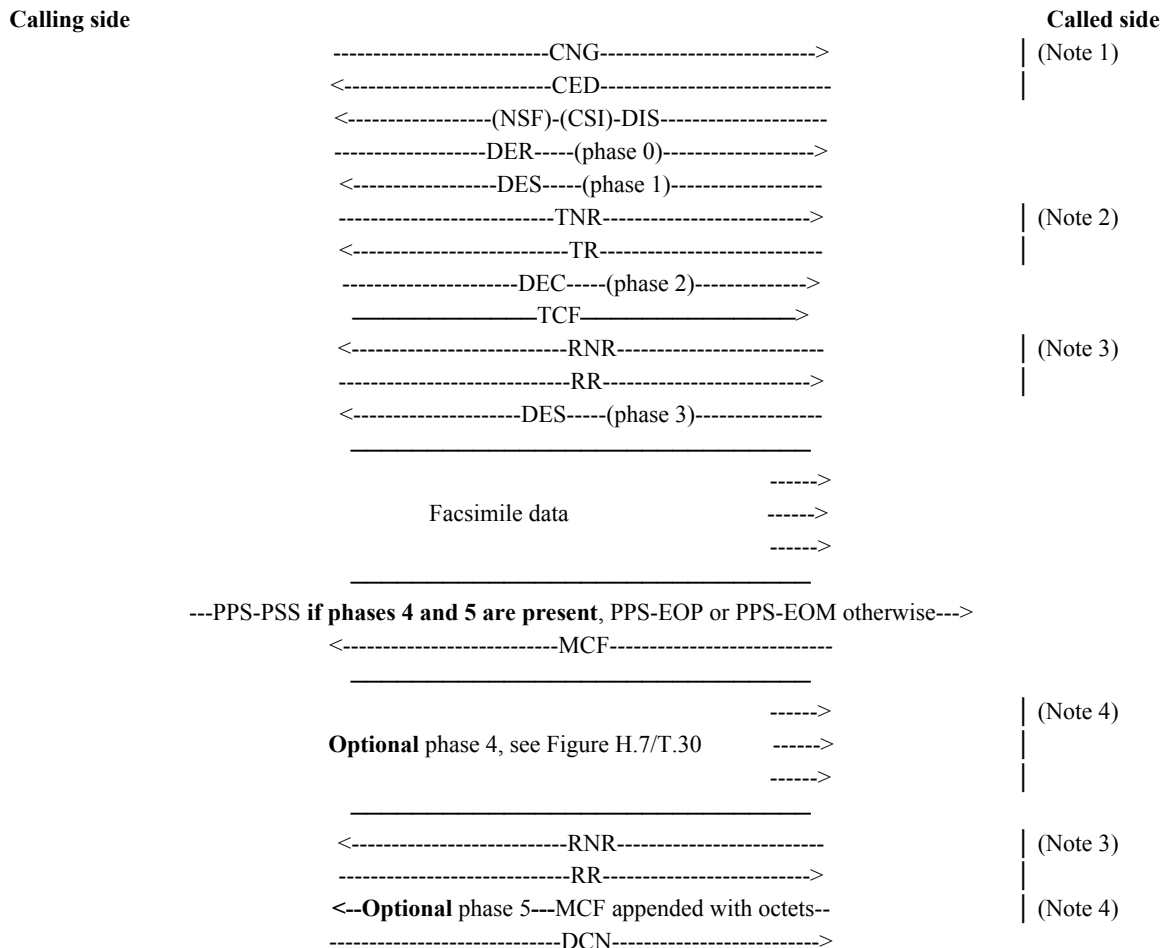
NOTE 3 – Additional parameters are present if the security page is used at phase 4.

Figure H.5/T.30 – Scheme of secure facsimile transmission mode

H.6.3.2 Use of DER, DES and DEC for secure facsimile transmission mode

H.6.3.2.1 General scheme for secure facsimile transmission mode

For the secure facsimile transmission mode, the signals DER, DES and DEC are used as in Figure H.6.



The timers used for the signals exchange above are the same ones as those for the standard T.30 protocol and Annex A (T1, T2, T4, T5, ...). Upon no response after timer T4, the command from the emitting side (DER, DEC or DNK) is resent (for DER and DEC, only the frames not yet acknowledged).

NOTE 1 – The call establishment CNG/CED which is depicted in the figure is given for example. The other operating methods defined in 3.1 may take place as well.

NOTE 2 – The use of TNR and TR is exactly the same one as the use of RNR/RR but concerns the emitting terminal instead of the receiving terminal. Some optional occurrences of the TNR-TR exchange can permit to the emitting terminal to hold off the receiving terminal during a maximum time of T5 (see Annex A).

NOTE 3 – Some optional occurrences of the RNR-RR exchange (already defined in Annex A) can permit to the receiving terminal to hold off the emitting terminal during a maximum time of T5 (see Annex A).

NOTE 4 – Phases 4 and 5 exist only if the service [Message integrity + Confirmation of message receipt] has been negotiated between the two parties (with the "Security services" parameter).

**Figure H.6/T.30 – Signals exchange for secure facsimile transmission mode
Example for a one facsimile page document**

H.6.3.2.2 Phase 4

When phase 4 (and then phase 5) is present, two cases exist depending on whether the security page capability has been negotiated between the two parties or not:

Case 1 – When both machines (emitting and receiving) provide the security page capability and the [Message integrity + Confirmation of message receipt] service is invoked, the security page solution (case 1) must be used.

Case 2 – When one of the two machines does not provide the security page capability and the [Message integrity + Confirmation of message receipt] service is invoked, the solution of PPS-EOP or PPS-EOM appended (case 2) must be used.

PPS-EOM (not appended in case 1, appended in case 2) is used if the communication is to be continued by another document.

PPS-EOP (not appended in case 1, appended in case 2) is used in the common case, with only one facsimile document during the communication.

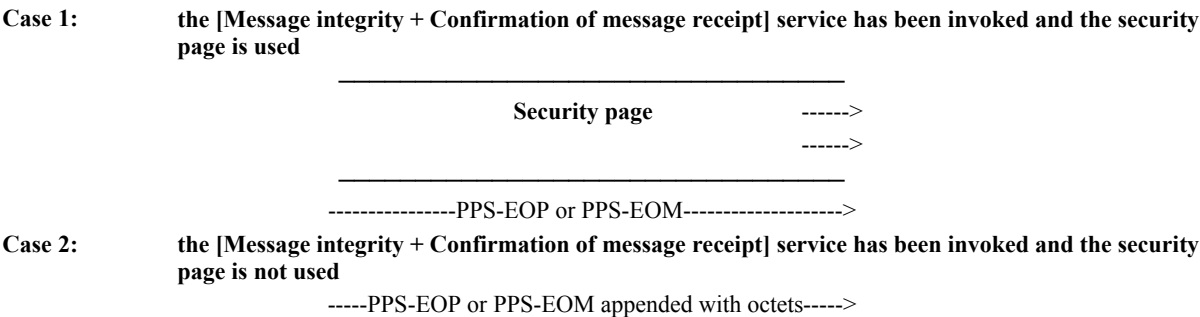


Figure H.7/T.30 – Signals exchange in phase 4

H.6.3.3 Bits allocation in the DIS

The bits allocation in the FIF of the DIS to indicate the security capabilities based on the RSA algorithm is given in Table 2. Bit No. 82 is used.

The DCS is not emitted in the context of Annex H; FIF of DCS is included within the new signal "DEC" where the corresponding bit No. 82 must be set to "1".

H.6.3.4 Format of Facsimile Information Field of DER, DES and DEC for secure facsimile transmission mode

H.6.3.4.1 Phase 0

The sequence contained in the FIF(s) of the DER is:

Super-tag "E-F"	Length of Supergroup	Tag "FIF of SUB"	Length + Content of "FIF of SUB"	Tag "FIF of SID"	Length + Content of "FIF of SID"	Tag "FIF of TSI"	Length + Content of "FIF of TSI"
--------------------	-------------------------	------------------------	--	---------------------	--	------------------------	--

Super-tag "Secure transmission mode"	Length of Supergroup	Tag "Optional lengths capability"	Length + Content of "Optional lengths capability"	Tag "Request of security capabilities"	Length + Content of "Request of security capabilities"
---	-------------------------	--	--	---	--

Tag "Unstandardized features"	Length + Content of "Unstandardized features"
-------------------------------------	--

If the calling side does not wish to use optional services and optional capabilities, the "Request of security capabilities" parameter is not sent. Secure facsimile transmission mode is carried on with the basic features (Sp, Rp 64 octets long, etc.) with the Mutual authentication service only invoked.

Also, if the calling side cannot handle random numbers of optional lengths (longer than the basic one), it does not have to send the "Optional lengths capability" parameter.

H.6.3.4.2 Phase 1

The sequence contained in the FIF(s) of the DES is:

Super-tag "Secure transmission mode"	Length of Supergroup	Tag "Rra"	Length + Content of "Rra"	Tag "Security services"	Length + Content of "Security services"
---	-------------------------	-----------	---------------------------------	-------------------------------	--

Tag "Security mechanisms"	Length + Content of "Security mechanisms"	Tag "Optional lengths capability"	Length + Content of "Optional lengths capability"	Tag "Unstandardized features"	Length + Content of "Unstandardized features"
---------------------------------	--	--	--	-------------------------------------	--

The optional [tag, length and parameter value] groups are present depending on the requests in phase 0 (bits in the "Request of security capabilities" parameter).

H.6.3.4.3 Phase 2

The sequence contained in the FIF(s) of the DEC is:

Super-tag "E-F"	Length of Supergroup	Tag "FIF of DCS"	Length + Content of "FIF of DCS"	Tag "FIF of SUB"	Length + Content of "FIF of SUB"	Tag "FIF of SID"	Length + Content of "FIF of SID"	Tag "FIF of TSI"	Length + Content of "FIF of TSI"
--------------------	-------------------------	------------------------	---	------------------------	---	------------------------	---	------------------------	---

Super-tag "Secure transmission mode"	Length of Supergroup	Tag "S"	Length + Content of "S"	Tag "Sra"	Length + Content of "Sra"	Tag "R"	Length + Content of "R"
---	-------------------------	------------	-------------------------------	--------------	---------------------------------	------------	-------------------------------

Tag "BE"	Length + Content of "BE"	Tag "Token 2" or "Token 2-enc."	Length + Content of "Token 2" or "Token 2-enc."
-------------	--------------------------------	---------------------------------------	--

Tag "Security services"	Length + Content of "Security services"	Tag "Security mechanisms"	Length + Content of "Security mechanisms"	Tag "Unstandardized features"	Length + Content of "Unstandardized features"
-------------------------------	--	---------------------------------	--	-------------------------------------	---

- Tag BE is present only if the service [Message confidentiality + Session Key establishment] is invoked. In such case, this is Token 2-enc. which is sent.
- Tags "Security services" is not present if the transmission is to take place with the Mutual Authentication service only.
- The "Security mechanisms" parameter is mandatory because it indicates the selected hash function.

H.6.3.4.4 Phase 3

The sequence contained in the FIF(s) of the DES is:

Super-tag "Secure transmission mode"	Length of Supergroup	Tag "R"	Length + Content of "R"	Tag "Rra"	Length + Content of "Rra"	Tag "Token 3"	Length + Content of "Token 3"
---	-------------------------	------------	-------------------------------	--------------	---------------------------------	------------------	-------------------------------------

H.6.3.4.5 Phase 4

Phases 4 and 5 exist only if the service [Message integrity + Confirmation of message receipt] has been negotiated between the two parties.

The signal sent in phase 4 is either the PPS-EOP (or PPS-EOM) signal appended with octets (case 2 depicted in Figure H.7) or the security page (case 1 depicted in Figure H.7).

When both machines (emitting and receiving) provide the security page capability and the [Message integrity + Confirmation of message receipt] service is invoked, the security page solution must be used.

The content of the security page is defined in H.6.4.

In case 2, the structure of the PPS-EOP (or PPS-EOM) appended with octets is the same as that of DER, DES, DEC and DTR (as defined in H.6.1.1): multiframes, bit X = 1 for final frame, FIF of 65 octets, frame numbers,

The FCF is that already defined in Annex A (see A.4.3).

The sequence contained in the FIF(s) of the PPS-EOP (or PPS-EOM) appended is:

Super-tag "Secure transmission mode"	Length of Supergroup	Tag "Srd"	Length + Content of "Srd"	Tag "UTCd"	Length + Content of "UTCd"	Tag "Lm"	Length + Content of "Lm"
---	-------------------------	--------------	---------------------------------	---------------	----------------------------------	-------------	--------------------------------

Tag "Token 4" or "Token 4-enc."	Length + Content of "Token 4" or "Token 4-enc."	Tag "Unstandardized features"	Length + Content of "Unstandardized features"
---------------------------------------	--	-------------------------------------	---

"Token 4" or "Token 4-enc." is sent depending on whether the service [Message confidentiality + Session Key establishment] has been invoked or not at phase 2.

H.6.3.4.6 Phase 5

Phases 4 and 5 exist only if the service [Message integrity + Confirmation of message receipt] has been negotiated between the two parties.

The signal sent at phase 5 is the MCF signal appended with octets.

The structure of the MCF appended with octets is the same as that of DER, DES, DEC and DTR (as defined in H.6.1.1): multiframes, bit X = 1 for final frame, FIF of 65 octets, frame numbers, etc.

The FCF is as already defined for the normal T.30 protocol (in 5.3.6.1).

The sequence contained in the FIF(s) of the MCF appended is:

Super-tag "Secure transmission mode"	Length of Supergroup	Tag "UTCr"	Length + Content of "UTCr"	Tag "Token 5" or "Token 5-enc."	Length + Content of "Token 5" or "Token 5-enc."
---	-------------------------	---------------	----------------------------------	---------------------------------------	--

"Token 5" or "Token 5-enc." is sent depending on whether the service [Message confidentiality + Session Key establishment] has been invoked or not at phase 2.

H.6.3.4.7 Error-messages

In case of errors detected in phase 1, 2, 3, 4 or 5, the sender or the recipient (depending on the phase) indicates the error with the signal FNV.

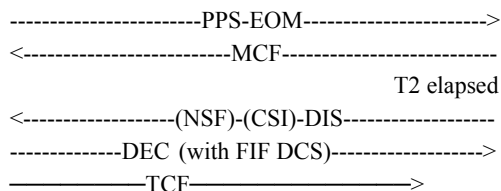
The reason of the error is coded in FNV.

Table H.10 gives the coding of the error value.

The use of FNV for error indication is explained in H.6.7.

H.6.3.5 Precisions for use of PPS-EOM within a secure document

Within the sequence of partial pages which constitute one secure document, the use of PPS-EOM is allowed (e.g., for changing the image resolution). The procedure after PPS-EOM is quite close as in Annex A:



In such a case, for setting the transmission of the remaining pages of the document, the DEC must contain the FIF of DCS [with the relevant bit(s) for security set to "1", as in phase 2]. The security parameters sent in phase 2 are not included in the DEC at this stage; they are valid throughout the transmission of the document.

H.6.4 At the message level: Security page

The use of the security page is defined in case 1 of Figure H.7.

When both machines (emitting and receiving) provide the security page capability and the [Message integrity + Confirmation of message receipt] service is invoked, the security page solution must be used.

H.6.4.1 Content of the security page

The "security page" contains the following security parameters defined in Tables H.1 and H.5:

Security-page-indicator	:	Indicates that the block contains the security page.
S	:	Identity of the sender.
Sp	:	Public Key of the sender.
R	:	Identity of the recipient.
Srd	:	Random number created by the sender for the digital signature.
UTCd	:	Date/time chosen by the sender (date/time of the generation/signature of the document).
Lm	:	Length of the document.
"Security services" parameter	:	See definition in Table H.6.
"Security mechanisms" parameter	:	See definition in Table H.8.
BE	:	RpE[S, Ks].
Token 4 or Token 4-enc.	:	See definition in Table H.5.
Security-Page-Type-Identification	:	Indicates the version number of the security page. In future versions of this annex, other types of security pages may be allowed, they will be given other version numbers.
Certification path	:	Certificate of the public key of the sender. The precise definition of the certification path is for further study.
Unstandardized features	:	Unstandardized features.

The bit order transmission within the security page follows the same rules as defined for FIF of DES/DEC/DER/DTR in H.4.8.2 and specified in Table H.1.

H.6.4.1.1 Coding of the "Security-page-indicator" parameter

This tag (and the relevant parameter) indicates that the block contains the security page.

The length octet is "0000 1000" (8 octets).

The content is (in hexadecimal):

0x01 0x23 0x45 0x67 0x89 0xAB 0xCD 0xEF

H.6.4.1.2 Coding of the "Security-Page-Type-Identification" parameter

This parameter is optional in the security page.

The length octet is "0000 0001" (1 octet).

The content is the version number of the security page. In this version of this annex, only one version of the security page exists, the version number is: 0x00.

H.6.4.2 Format of the security page

The security page has exactly the same kind of format as the sequences within the DER, DES, DEC and DTR signals (super-tags, tags and parameters values), except that in this case, the sequence is not placed in the series of FIF of DER, DES, DEC or DTR, but in the ECM frames.

Within the sequence of tags introduced by the super-tag, **the order is unfixed**, except the Security-page-indicator which is the first one.

The sequence is the following:

Super-tag "Secure transmission mode"	Length of Supergroup	Tag "Security- page- indicator"	Length + Content of "Security-page- indicator"	Tag "S"	Length + Content of "S"	Tag "Sp"	Length + Content of "Sp"
---	-------------------------	--	---	------------	-------------------------------	-------------	--------------------------------

Tag "R"	Length + Content of "R"	Tag "Srd"	Length + Content of "Srd"	Tag "UTCd"	Length + Content of "UTCd"	Tag "Lm"	Length + Content of "Lm"
------------	-------------------------------	--------------	---------------------------------	---------------	----------------------------------	-------------	--------------------------------

Tag "Security services"	Length + Content of "Security services"	Tag "Security mechanisms"	Length + Content of "Security mechanisms"
-------------------------------	--	---------------------------------	--

Tag "BE"	Length octet + Content of "BE"
-------------	--------------------------------------

Tag "Token 4" or "Token 4-enc."	Length + Content of "Token 4" or "Token 4-enc."	Tag "Security-Page- Type- Identification"	Length + Content of "Security-Page-Type- Identification"
---------------------------------------	--	--	--

Tag "Certification path"	Length + Content of "Certification path"	Tag "Unstandardized features"	Length + Content of "Unstandardized features"
--------------------------------	---	-------------------------------------	---

NOTE 1 – The bits in the Security services and Security mechanisms parameters are set in conformance with respectively Tables H.6 and H.8 [version of the security system, bit indicating the hash function used, bit indicating the encipherment algorithm used (if document enciphered)].

NOTE 2 – Parameter BE is present only if the service [Message confidentiality + Session Key establishment] has been invoked.

NOTE 3 – The format of the certification path is for further study.

H.6.5 Rules for hashing the document – Rules for enciphering the document

H.6.5.1 Rules for hashing the document

The data of the document which are part of the bit string which is hashed are all the octets contained in the FIF of all the ECM data frames except the first octet of each frame (which is the frame number). Therefore, any fill bits and pad bits (as described in A.3.6.2/T.4 and in 2.4.1.2/T.6) are part of the data which pass through the hash function.

The bit stream entering in the hashing process for producing $h(\text{document})$ or $h(\text{enc.document})$ (in case of encipherment) can be represented as the bit string contained in the rectangle depicted in Figure H.8.

For each octet, this bit string has the same bit order in the hashing process as the data bits of each octet when transmitted over the line.

First page		
<i>First block:</i>		
First frame FIF	: frame number	first data octet last octet of FIF
Second frame FIF	: frame number	first data octet last octet of FIF
...		
Last frame FIF	: frame number	first data octet last octet of FIF
<i>Second block:</i>		
First frame FIF	: frame number	first data octet last octet of FIF
Second frame FIF	: frame number	first data octet last octet of FIF
...		
Last frame FIF	: frame number	first data octet last octet of FIF
...		
...		
<i>Last block:</i>		
First frame FIF	: frame number	first data octet last octet of FIF
Second frame FIF	: frame number	first data octet last octet of FIF
...		
Last frame FIF	: frame number	first data octet last octet of FIF
Second page		
...		
...		
...		
Last page		
...		
...		
<i>Last block:</i>		
First frame FIF	: frame number	first data octet last octet of FIF
Second frame FIF	: frame number	first data octet last octet of FIF
...		
Last frame FIF	: frame number	first data octet last octet of FIF

Figure H.8/T.30 – Rules for hashing the document

H.6.5.2 Rules for enciphering the document

The data of the document which will be encrypted are the octets contained in the FIF of the ECM data frames except the first octet of each frame (which is the frame number).

The input bit order to the encryption function is the same order as the one when the facsimile data are transmitted over the line without encryption.

NOTE – For FEAL-32, these data are aligned every 64 bits in order from the left to the right and are input to FEAL-32 function.

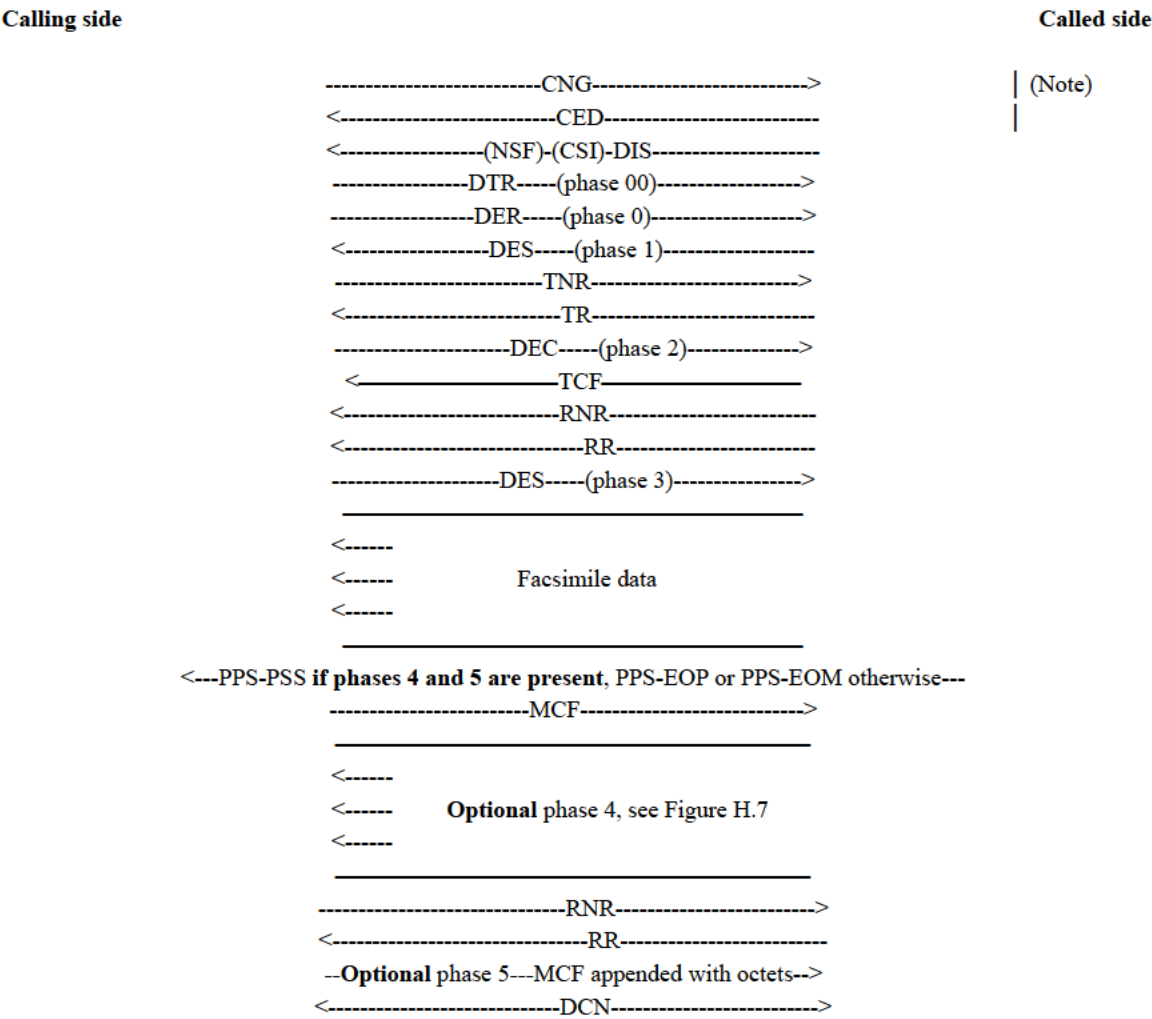
Every 64 bits of the encrypted data from FEAL-32 function are aligned in order from the left to the right, and the left-most bit is transmitted first.

H.6.6 Secure polling mode

H.6.6.1 Simple polling

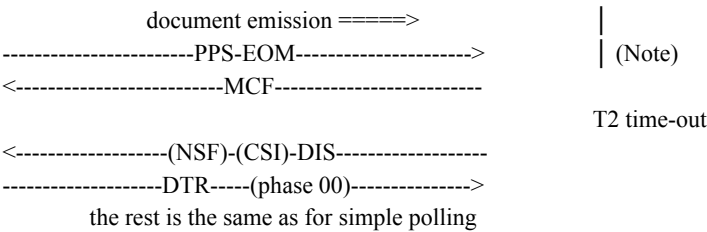
The use and the coding of the signals in the secure polling mode follows the same rules as for the secure facsimile transmission mode.

The signals exchange is depicted in Figure H.9.



H.6.6.2 Turnaround polling

In case of turnaround polling, after DIS received, the sequence of phases (00, 0, 1, 2, 3 and 4) takes place exactly as for simple polling.



NOTE – If the document sent before the turnaround polling is sent with secure facsimile transmission mode, the rules in H.6.3.2 apply: if phases 4 and 5 are present, the security page is sent or the PPS-EOM appended with octets is sent and the response MCF is appended with octets.

H.6.7 Error messages

H.6.7.1 Error messages

When an error message is to be indicated, the bit No. 5 of the Reason octet of FNV (bit indicating "Secure Fax Error") must be set to "1".

FNV is defined in 5.3.6.2.13.

The error reason is contained in the Diagnostic Information Octets of FNV.

The Type octet for error messages is "Secure Fax Error" as defined in 5.3.6.2.13.

Table H.10 specifies the octets contained in the Value field of "Secure Fax Error".

Table H.10/T.30 – Error reasons coded in the value field of Secure Fax Error in FNV

Coding of the value octets in FNV									Error reasons
									First octet
Bit No.	7	6	5	4	3	2	1	0	Registration error for public key
	x	x	x	x	x	x	x	1	
Bit No.	7	6	5	4	3	2	1	0	Registration error for encipherment public key
	x	x	x	x	x	x	1	x	
Bit No.	7	6	5	4	3	2	1	0	Service not supported
	x	x	x	x	x	1	x	x	
Bit No.	7	6	5	4	3	2	1	0	Party not registered
	x	x	x	x	1	x	x	x	
Bit No.	7	6	5	4	3	2	1	0	Authentication failure
	x	x	x	1	x	x	x	x	
Bit No.	7	6	5	4	3	2	1	0	Receipt not confirmed (Srd non valid)
	x	x	1	x	x	x	x	x	The Random number received is rejected by the recipient (e.g., in case of replay detected)
Bit No.	7	6	5	4	3	2	1	0	Receipt not confirmed (UTCd non valid)
	x	1	x	x	x	x	x	x	The recipient does not accept the UTCd received from the sender (the criteria are implementation matter)

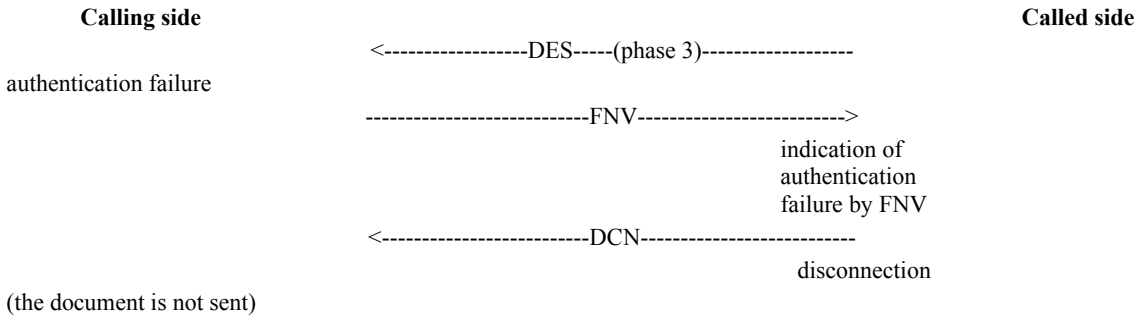
Table H.10/T.30 – Error reasons coded in the value field of Secure Fax Error in FNV

Coding of the value octets in FNV		Error reasons
		First octet
Bit No.	7 6 5 4 3 2 1 0 1 x x x x x x x	Receipt not confirmed (Lm non valid) The length indicated by the sender does not correspond to the actual length of the document received
		Second octet
Bit No.	7 6 5 4 3 2 1 0 x x x x x x x 1	Receipt not confirmed (Token 4 or Token 4-enc. non valid) The recipient finds the digital signature by the sender not correct
Bit No.	7 6 5 4 3 2 1 0 x x x x x x 1 x	Receipt not valid (Token 5 or Token 5-enc. non valid)
NOTE 1 – Several reasons may be indicated together (several bits set to "1").		
NOTE 2 – In future versions of this annex, more additional octets may be defined to code other error reasons.		
NOTE 3 – For each octet, the least significant bit (right-most bit) is the first one transmitted.		

H.6.7.2 Use of FNV for error indication

Once the FNV indicating the Secure Fax error has been sent, the terminal which has received it "acknowledges" it in sending DCN and disconnects the line.

An example is given below where authentication of the recipient at phase 3 of the secure facsimile transmission fails.



Annex I

Procedure for the Group 3 document facsimile transmission of colour and gray-scale images using T.43

I.1 Introduction

This annex describes the additions to this Recommendation to enable the transmission of colour and gray-scale images using lossless coding method defined by ITU-T Rec. T.43 for Group 3 facsimile mode of operation.

This Recommendation is an optional colour and gray-scale mode which shall only be implemented if the associated base colour and gray-scale mode defined in Annex E/T.4 is also implemented.

Implementation of the gray-scale mode of ITU-T Rec. T.43 requires implementation of the associated gray-scale mode of Annex E/T.4. Similarly, implementation of the colour mode of ITU-T Rec. T.43 requires implementation of the associated colour mode of Annex E/T.4.

The objective is to enable the efficient transmission of a wide variety of images, from a simple document such as containing red or blue characters to high-quality full-colour/gray-scale images over the general switched telephone network and other networks. The images are normally obtained by scanning the original sources with scanners of 200 pels/25.4 mm or higher. The original sources are typically business documents underlined with assorted colour, computer-generated business graph, palettized colour images and high definition continuous-tone colour and gray-scale images.

In this annex, three types of images are supported. They are one-bit per colour CMY(K)/RGB image, palettized colour image and continuous-tone colour and gray-scale image. One-bit per colour CMY(K)/RGB image is also represented using colour palette table, and is a special case of palettized colour image in which every colour is represented by one bit information of original printable colour. The representation of colour image data is based on ITU-T Recs T.42 and T.43. The basic way is a device-independent colour space representation, the CIELAB space, which enables unambiguous exchange of colour information. The bit-plane decomposition and coding using ITU-T Rec. T.82 is also described in ITU-T Rec. T.43.

This annex describes the procedure for negotiation of the capabilities for transmission of colour and gray-scale images. It specifies the definitions and the specifications of new entries to the Facsimile Information field of the DIS/DTC and DCS frames of this Recommendation.

Information pertaining to receiver capability, colour mode capability, image amplitude precision in digitization (bits/component), interleave method, custom illumination, and custom gamut are subject to negotiation in the pre-message phase of the T.30 protocol.

This annex does not address the semantics and syntax of the actual encoding of the colour and gray-scale images by lossless coding. Such information is included in ITU-T Rec. T.43.

The use of Error Correction Mode (ECM) for error-free transmission is mandatory in the procedure described by this annex. Under the error-correction mode of transmission, the encoded image data sequence is embedded in the Facsimile Coded Data (FCD) part of the HDLC (High-level Data Link Control) transmission frames specified by Annex A.

I.2 Definitions

I.2.1 CIE (L^* a^* b^*) space (CIELAB): A colour space defined by the CIE (*Commission internationale de l'éclairage*), having approximately equal visually perceptible difference between equally spaced points throughout the space. The three components are L^* (in Lightness), a^* and b^* (both in chrominance).

I.2.2 Joint Bi-level Image experts Group (JBIG), and also shorthand for the encoding method, described in ITU-T Rec. T.82, which was defined by this group.

I.3 Normative references

- ITU-T Recommendation T.4 (2003), *Standardization of Group 3 facsimile terminals for document transmission*.
- ITU-T Recommendation T.42 (2003), *Continuous-tone colour representation method for facsimile*.
- ITU-T Recommendation T.43 (1997), *Colour and gray-scale image representations using lossless coding scheme for facsimile*.
- ITU-T Recommendation T.82 (1993) | ISO/IEC 11544:1993, *Information technology – Coded representation of picture and audio information – Progressive bi-level image compression*. (Commonly referred to as JBIG standard.)

I.4 Negotiation procedure

The negotiation to transmit and receive encoded colour and gray-scale images by lossless bit-plane coding under the Group 3 facsimile protocol is invoked through the setting of the bits in the DIS/DTC and DCS frames during the pre-message procedure (Phase B) of the T.30 protocol.

The above three image types are further divided into 7 coding submode classes as specified in Table G.1/T.4. The relation of 4 coding mode classes and 7 coding submode classes to be supported are shown in Table G.2/T.4.

The relation of 7 coding submode classes and 4 coding mode classes, which are given by the combination of bits 36, 69 and 71, are given in Table I.1.

In Table I.1, the capability of lossless gray-scale/colour coding, number of palette indices, and the number of bit precision are explicitly described. Parameters to be negotiated can be found in Table I.2.

Table I.1/T.30 – The correspondence of coding submode classes and DIS/DTC/DCS bits

Coding submode class		Colour space	Bit 36 T.43 coding	Bit 69 Colour mode	Bit 71 12-bit mode	
Image type	# of bit plane					
One-bit per colour image	(3, 4)		1	1	0	(Note)
Palettized colour image	Basic (1-12) × 1 8 bits precision	Lab	1	1	0	
	Extended (1-12) × 1 12 bits precision or (13-16) × 1 8 or 12 bits precision	Lab	1	1	1	
Continuous-tone image	Gray-scale					
	2-8	L	1	0	0	
	9-12	L	1	0	1	
	Colour					
	(2-8) × 3	Lab	1	1	0	
	(9-12) × 3	Lab	1	1	1	
NOTE – This coding submode is a special case of palettized colour submode, in which each bit plane corresponds to CMY(K) or RGB primaries. The number of planes (3 or 4) will be distinguished by G3FAX0 Entry.						

Table I.2/T.30 – Mandatory and optional capabilities

Mandatory	Optional
T.43 gray-scale	T.43 colour
8-bit mode	12-bit mode
Stripe interleave	Plane interleave
CIE standard illuminant D50	Custom illuminant
Default gamut range	Custom gamut range

Annex J

Procedure for Group 3 document facsimile transmission of Mixed Raster Content (MRC) images

J.1 Scope

The method for Mixed Raster Content (MRC) image representation is defined in ITU-T Rec. T.44. Together with Annex H/T.4, this annex provides specification for the application of MRC in Group 3 facsimile. Unconstrained MRC, as defined in ITU-T Rec. T.44, shall be applied as a colour option of Annex E/T.4 (i.e., Annex E/T.4 shall be implemented in unconstrained MRC applications). Black-and-white constrained MRC, as defined in Annex H/T.4, shall be implemented in non-colour applications (i.e., applications that do not implement Annex E/T.4). MRC defines a means to efficiently represent raster-oriented pages that contain a mixture of multilevel (e.g., continuous-tone and palettized colour) and bi-level (e.g., text and line-art) images by combining different encodings, spatial and colour resolutions on a single page. More than one of the multilevel encodings (e.g., T.81 and T.82 as per ITU-T Rec. T.43) and/or bi-level encodings (e.g., T.6 and T.4, one and two-dimensional) which are negotiated (as defined within this annex) may be combined within a page, however, only bi-level encodings may be used in the MRC mask layer. Similarly, more than one of the square spatial resolutions (same resolution in both horizontal and vertical direction) and colour resolutions (i.e., bits/pels/component and chrominance subsampling) which are negotiated (as defined within this annex) may be combined within a page. This annex does not introduce new encodings or resolutions. The method of image segmentation is beyond the scope of this annex; segmentation is left to the manufacturer's implementations.

J.2 References

- ITU-T Recommendation T.4 (2003), *Standardization of Group 3 facsimile terminals for document transmission*.
- ITU-T Recommendation T.44 (2005), *Mixed Raster Content (MRC)*.

J.3 Definitions

The definitions in ITU-T Rec. T.44 apply to this annex.

J.4 Image representation

This annex makes provision for encapsulating two or more ITU-T encodings, spatial and colour resolutions as defined in ITU-T Rec. T.44 "Mixed Raster Content (MRC)". This provision marks a significant departure from normal T.30 procedures that typically permits only a single encoding, spatial and colour resolution within a page.

A page is composed from a set of page-wide stripes of image data, which are coded independently. The stripes are transmitted sequentially from the top to the bottom of the page. Data is transmitted in a bit stream of least to most significant bit order.

The different segments of the raster data are processed according to their individual attributes; text and line-art data (bi-level data), pictures and colour gradients (multilevel data). These different data types (bi-level and multilevel) are placed in separate layers/planes within the page and processed appropriately. The spatial details associated with text and line-art data is in the mask layer(s) (odd-numbered layers) while the colour details of the text and line-art data is in the image layers (odd-numbered layers such as the "foreground" layer). The continuous-tone colours associated with pictures and colour sweeps are in the lower "background" layer. The process of image regeneration is controlled by the bi-level mask layer(s) selecting whether pixels from the image layer below,

such as background (e.g., contone) or image layer above, such as foreground (e.g., text/line-art colour) will be reproduced.

The stripes are composed of one or more layers. No more than 3 types of stripes shall be used when applying the base mode (Mode 1) or Mode 2 of ITU-T Rec. T.44. Mode 3 defines provisions for more than three, up to N (where N is an integer), types of stripes. Stripe types are classified according to their layer (image type) content:

- N-layer stripe (NLS) where N is an integer, so referenced since it contains more than three layers.
- 3-layer stripe (3LS), so referenced since it contains all three of the foreground, mask and background layers.
- 2-layer stripe (2LS), so referenced since it contains coded data for two of the three layers (the third is set to a fixed value). The two layers may be mask and foreground or mask and background layers.
- 1-layer stripe (1LS), so referenced since it contains coded data for only one of the three layers (the other two are set to fixed values). The one layer may be mask, foreground or background. The 1LS is appropriate when addressing an image that contains one of monochrome text/line-art, contone image or possibly richly coloured graphics.

Each layer is coded using a recommended ITU-T encoding, spatial and colour resolution. A different encoding and colour resolution may be applied within each layer. The square spatial resolutions (same resolution in both horizontal and vertical direction) of Table 2 are available for use in this annex. The resolution of the main mask layer is fixed for the entire page. In general, it is possible to define lower spatial resolution for other layers. Within a stripe, varying spatial resolutions may be combined only when the resolutions of the other layers are integral factors of the main mask resolution. For example, if the main mask resolution is 400 pels/25.4 mm, the background and foreground layers may each be either 100, 200 or 400 pels/25.4 mm. The main mask resolution is specified in the page header. The resolutions of the other layers are specified in the layer data.

These encodings, spatial and colour resolutions are selected from a set that is negotiated at the start of the session.

Information required to decode the page, such as coding types available for use within the layers, is specified within the page header (start of page marker segment). Maximum Stripe height shall be negotiated at the start of the session. Mode 1 requires the actual applied stripe height to be specified within the stripe header (start of stripe marker segment) while other modes require its specification within the layer data structure. Information required to decode a layer is included in the stripe header and the layer data.

The main mask (layer 2) shall be transmitted first, followed by the background (layer 1) the foreground (layer 3), layer 4, layer 5 ..., layer N. Details of the syntax are described in ITU-T Rec. T.44.

The use of error correction mode (ECM) for error-free transmission, as defined in Annex A/T.4 and this Recommendation, is mandatory for the procedure specified in ITU-T Rec. T.44. Under the ECM mode of transmission the encoded image data sequence, associated headers and the layer data are embedded in the Facsimile Coded Data (FCD) part of the HDLC (High Level Data Link Control) transmission frames that are specified in Annex A. In alignment with Annex A/T.4, to complete the last frame, pad characters (X'00', the null character) may be added after ending marker within the last ECM frame of the page.

J.4.1 Black-and-white only or colour representation

The unconstrained MRC provisions accommodating use of multilevel and/or bi-level coders within a page shall only be implemented when the facsimile base colour mode, as defined in Annex E/T.4, is also implemented (i.e., Baseline JPEG is implemented). In other words, unconstrained MRC is a colour option of Annex E/T.4. When Annex E/T.4 is not implemented, then only the bi-level coder constrained provisions of MRC, as defined in the "Black-and-White Mixed Raster Content Profile (MRCbw)" clause H.5.5/T.4, shall be implemented. The MH (T.4 one-dimensional) coder is the only required coder when implementing MRCbw.

All modes of MRC are available for use with Black-and-White Mixed Raster Content Profile; however, use of Modes 2 or higher modes is strongly recommended.

J.4.2 Shared data representation

MRC Mode 4 requires implementation of the SDMx (Share Data) marker segment provision to share coding information between pages, stripes or layers. The SDMx marker segment provision may be used with any encoder that benefits from sharing information between pages, stripes or layers. The JBIG2 encoder, however, shall only be used in combination with the SDMx marker segment provision.

J.4.3 Colour tag representation

The MRC Mode 4 optional colour tag provisions may be implemented in the representation of foreground colour. The T.45 "Run-length Encoder" shall be used to code the colour values of the foreground colour tags. Colour tags shall only be used with foreground layers that are associated with JBIG2 encoded mask layers.

J.5 Layer transmission order

In multi-layer stripes, the bi-level main mask data is transmitted first, followed by the background layer, the foreground layer, layer 4, layer 5, ..., layer N. In a multi-layer stripe without a background layer, the bi-level main mask image data is transmitted first, followed by the foreground, layer 4, layer 5, ..., layer N.

J.6 Negotiation

Negotiations to use the MRC (T.44) procedure, accommodating the transmission and reception of pages with mixed coding (i.e., encoding method, spatial and colour resolution, and other encoding parameters) and/or JBIG2 coding, shall be invoked through the setting of a sequence of bits in the DIS/DTC and DCS frames during the T.30 pre-message procedure (Phase B). This optional MRC procedure is only available when the base colour encoding mode, as defined in ITU-T Rec. T.42, Annex E/T.4 and Annex E, or the Black-and-White MRC Profile is available, as indicated by the setting of Table 2 bit 68 to "1" or bit 115 to "1" respectively. Provision is made, via the value of Table 2 bits 92-94, to negotiate one of the many modes (performance level) of ITU-T Rec. T.44 to be implemented during a transmission session. Table 2, Note 50, specifies the T.44 modes that are currently available for negotiations. Modes 1 and 2 make provision to apply one encoding scheme, one spatial and one colour resolution within each of the three layers of a stripe. Mode 3 and higher modes make provision to apply one encoding scheme, one spatial and one colour resolution within each of N layers per stripe, where N is an integer. Consult ITU-T Rec. T.44 to determine all the provisions made available by each mode.

Under the MRC procedure any of the different multilevel and bi-level coding methods, negotiated in Phase B, may be used in each of the layers. A bi-level coder must be used for the mask layer(s). Multilevel and bi-level encodings such as defined in: ITU-T Rec. T.42, Annex E/T.4 and Annex E; ITU-T Rec. T.43, Annex G/T.4 and Annex I; ITU-T Recs T.6 and T.4 are available. Multiple coding methods may be negotiated for use during Phase B by activating more than one coding

related bits in the DCS. The coding bits activated in the DCS must be a subset of those activated in the DIS. Different colour resolutions and/or subsamplings may be used between layers in the event that the DIS indicates 12 bits/pel component and/or no subsampling (1:1:1) is available. If the DCS indicates 12 bits/pel component then 8 bits/pel component may also be sent (e.g., 12 applied to the background while 8 is applied to the foreground, 12 applied to one page while 8 is applied to another). In the same manner, if the DCS indicates no subsampling, then subsampling may be applied. These combinations are possible since the receiver is required to support both base modes. Additionally the applied coder, bit resolution and subsampling are identified in the layer data stream.

Multiple spatial resolutions may be negotiated for use during Phase B by activating more than one resolution related bits in the DCS. The resolution bits activated in the DCS must be a subset of those activated in the DIS. All layer resolutions must be an integral factor of the main mask layer resolution. Resolution may vary between mask layers, as long as the mask layer resolution is one of the set identified in the DCS. The main mask layer resolution is identified in the start of page marker segment.

Maximum stripe size may be negotiated between the default size of 256 lines maximum and the full height of the page. This negotiated stripe size maximum may only be changed following EOM and DIS/DCS negotiations.

J.7 Application requirements summary

- 1) Only bi-level ITU-T coders shall be used in mask layers (i.e., even-numbered layers).
- 2) The Black-and-White MRC Profile, defined in Annex H/T.4, shall contain only mask layer data. The colours of the background layer (i.e., layer 1) and the foreground layers (i.e., odd-numbered layers greater than one) shall be fixed to black and white respectively.
- 3) Coders may vary between layers and between stripes within a layer; however, the main mask coder shall be fixed for the entire page.
- 4) All implementations shall include the MH (T.4 one-dimensional) bi-level coder, other ITU-T bi-level coders may be used.
- 5) Implementations other than Black-and-White MRC Profile shall include the Baseline JPEG (T.81, as defined in Annex E/T.4) multilevel coder, other multilevel coders may be used within the image layers (i.e., odd-numbered layers).
- 6) Only square (i.e., same resolution value in vertical and horizontal directions) ITU-T spatial resolutions shall be used.
- 7) Spatial and colour resolution may vary between layers and between stripes within a layer; however, the spatial resolution of all layers shall be integral factors of the main mask layer resolution and the main mask resolution shall be fixed for the entire page.
- 8) Dimensions of the main mask layer shall be such that the main mask layer(s) cover the entire page (i.e., each stripe has a mask layer that has a zero horizontal offset, the mask layer is always the page width, the stripe size is defined by the mask layer, and there are stripes that traverse the entire page height).
- 9) Pages may be subdivided into one or more contiguous horizontal stripes.
- 10) Maximum stripe heights of 256 lines or full page shall be accommodated.
- 11) Stripe width shall span the width of the page.
- 12) Dimensions of the main mask layer within a stripe shall be the same as the stripe dimensions.
- 13) Dimensions of other layers within a stripe may be the same as or less than the stripe dimensions.

- 14) A maximum of three (3) layers may be used in Mode 1 and Mode 2, while the number of layers are unrestricted in Mode 3 and higher level modes.
- 15) Error Correction Mode (ECM) shall be used during all transmissions.
- 16) Stripe transmission order within a page shall be in order of increasing stripe numbers.
- 17) Layer transmission order within a stripe shall be main mask layer (i.e., layer 2) first, followed by the background layer (i.e., layer 1), then the foreground layer (i.e., layer 3) and any other layers in order of increasing layer numbers (i.e., layers 4, 5, 6, 7, ..., N). In the event that there is no background layer then the foreground layer shall immediately follow the main mask layer and any other layers in order of increasing layer numbers.
- 18) Layers shall be recombined and rendered in ascending order of layer numbers (i.e., layer 1 is rendered first, next layer 3 on top of layer 1, then layer 5 on top of the 1 and 3 combination, and so on until all layers have been rendered).
- 19) Mode 2 and higher mode implementations shall use the Start of Layer Coded Data (SLC) marker segment to specify information required to decode the coded layer data, such as layer coder, resolution, width, height, base colour and offset. Mode 1 implementations shall specify this information in the Start of Stripe (SOST) marker segment.
- 20) Mode 4 and higher mode implementations may use the Shared Data (SDMx) marker segment to accommodate sharing of coding information between pages.
- 21) A JBIG2 encoded stream shall only be used in combination with the Mode 4 SDMx marker segment provision.
- 22) Shared data create (SDMc) marker segments must appear before the data stream (JBIG2) that uses the shared resources.
- 23) Shared data disposition (SDMd) marker segments identifying "use" of previously declared shared data resource(s) must appear before the layer in which the resource(s) is(are) used, and not before other layers. In other words, SDMd marker segments appear between layers and prior only to the layer that it will be used for. This could be between the SLC and EOH (unambiguously) or before or after the SOST, if the use is for the first layer. Implementations must accommodate any of these placements.
- 24) The Black-and-White Mixed Raster Content Profile (MRCbw) (per Annex H/T.4) shall be used for black-and-white only applications of JBIG2.
- 25) Mode 4 and higher mode implementations may use T.45 "Run-length Colour Encoder" and colour tags provisions to code foreground layers, as defined in Annex B/T.44 and Annex H/T.4, only when JBIG2 is used to code the corresponding mask layers.
- 26) Unknown marker segments should be skipped (i.e., unknown APP1, APP3, and APP13 identifiers).

Annex K

Procedure for the Group 3 document facsimile transmission of continuous-tone colour and gray scale images (sYCC)

K.1 Introduction

This annex describes the additions to this Recommendation to enable the transmission of continuous-tone colour and gray scale images (sYCC) for Group 3 facsimile mode of operation.

The objective is to enable the efficient transmission of high-quality, multilevel images over the general switched telephone network and other networks. The images are normally obtained by

capturing the original sources with, for example, digital still-image cameras, and bit depths of eight bits per picture element per colour component or higher.

The encoding methodology for continuous-tone colour and gray scale images (sYCC) is based on the JPEG (ITU-T Rec. T.81 | ISO/IEC 10918-1) image encoding standard. The JPEG image coding method includes both a lossy mode and a lossless mode of encoding. This annex adopts the lossy mode of encoding which is based on the Discrete Cosine Transform.

The representation of colour image data is based on Annex F of IEC 61966-2-1 (8-bits sYCC values). It adopts colour space representation, the sYCC colour space.

This annex explains the procedure for negotiation of the capabilities for transmission of continuous-tone colour and gray scale images (sYCC). It specifies the definitions and the specifications of new entries to the Facsimile Information Field of the DIS/DTC and DCS frames of this Recommendation.

The two types of information specified – that pertaining to JPEG capability and the sYCC colour space – are subject to negotiation in the pre-message phase of the T.30 protocol.

This annex does not address the semantics and syntax of the actual encoding of the continuous-tone colour and gray scale images (sYCC). That information is included in Annex I/T.4.

The use of Error Correction Mode (ECM) for error-free transmission is mandatory in the procedure described by this annex. Under the error correction mode of transmission, the JPEG encoded image data are embedded in the Facsimile Coded Data (FCD) part of the HDLC (High-level Data Link Control) transmission frames specified by Annex A.

The technical features of encoding and decoding the continuous-tone colour and gray scale images (sYCC) data are described in Annex I/T.4. It describes two modes of image encoding (lossy gray-scale and lossy colour) which are defined using ITU-T Rec. T.81.

K.2 Definitions

K.2.1 sYCC: A colour space defined by the IEC (International Electrotechnical Commission) in Annex F of IEC 61966-2-1.

K.2.2 Joint Photographic Experts Group (JPEG): Shorthand for the encoding method, described in ITU-T Rec. T.81, which was defined by this group.

K.2.3 baseline JPEG: A particular eight-bit sequential Discrete Cosine Transform (DCT)-based encoding and decoding process specified in ITU-T Rec. T.81.

K.2.4 quantization table: A set of 64 values used to quantize the DCT coefficients in baseline JPEG.

K.2.5 Huffman table: A set of variable length codes required in a Huffman encoder and a Huffman decoder.

K.3 References

- IEC 61966-2-1-Amd 1:2003, *Multimedia systems and equipment – Colour measurement and management – Part 2-1: Colour management – Default RGB colour space – sRGB*.
- ITU-T Recommendation T.81 (1992) | ISO/IEC 10918-1:1994, *Information technology – Digital compression and coding of continuous-tone still images – Requirements and guidelines*. (Commonly referred to as JPEG standard.)
- ITU-T Recommendation T.4 (2003), *Standardization of Group 3 facsimile terminals for document transmission*.

K.4 Negotiation procedure

The negotiation to transmit and receive JPEG encoded continuous-tone colour and gray scale images (sYCC) under the Group 3 facsimile protocol is invoked through the setting of the bits in the DIS/DTC and DCS frames during the pre-message procedure (Phase B) of the T.30 protocol.

Table K.1/T.30 – Mandatory capabilities

Mandatory
8 bits/pel/component
Subsampling less than MCU 10
CIE Standard Illuminant D65
Default gamut range (Annex F of IEC 61966-2-1 Default range)

Appendix I

Index of abbreviations used in this Recommendation

Abbreviation	Function	Signal format	Reference
ANSam	Modulated answer tone	See ITU-T Rec. V.8.	4.1.2
CED	Called terminal identification	2100 Hz	4.1.1
CFR	Confirmation to receive	X010 0001	5.3.6.1.4, 1)
CI	Call indicator	See ITU-T Rec. V.8.	F.5
CIG	Calling subscriber identification	1000 0010	5.3.6.1.2, 2)
CJ	CM terminator	See ITU-T Rec. V.8.	F.5
CM	Call menu	See ITU-T Rec. V.8.	F.5
CNG	Calling tone	1100 Hz for 500 ms	4.2
CRP	Command repeat	X101 1000	5.3.6.1.8, 2)
CSI	Called subscriber identification	0000 0010	5.3.6.1.1, 2)
CTC	Continue to correct	X100 1000	A.4.1
CTR	Response for continue to correct	X010 0011	A.4.2
DCN	Disconnect	X101 1111	5.3.6.1.8, 1)
DCS	Digital command signal	X100 0001	5.3.6.1.3, 1)
DIS	Digital identification signal	0000 0001	5.3.6.1.1, 1)
DTC	Digital transmit command	1000 0001	5.3.6.1.2, 1)
EOM	End of message	X111 0001	5.3.6.1.6, 1)
EOP	End of procedure	X111 0100	5.3.6.1.6, 3)
EOR	End of retransmission	X111 0011	A.4.3, 2)
ERR	Response for end of retransmission	X011 1000	A.4.4, 3)
FCD	Facsimile coded data	0110 0000	A.2.2
FCF	Facsimile control field	–	5.3.6.1
FDM	File diagnostic message	X011 1111	5.3.6.1.7, 9)
FIF	Facsimile information field	–	5.3.6.2

Abbreviation	Function	Signal format	Reference
FTT	Failure to train	X010 0010	5.3.6.1.4, 2)
HDLC	High-level data link control	–	5.3
JM	Joint menu	See ITU-T Rec. V.8.	F.5
MCF	Message confirmation	X011 0001	5.3.6.1.7, 1)
MPh	Modulation parameter	See ITU-T Rec. V.34.	F.3.1.4
MPS	Multipage signal	X111 0010	5.3.6.1.6, 2)
NSC	Non-standard facilities command	1000 0100	5.3.6.1.2, 3)
NSF	Non-standard facilities	0000 0100	5.3.6.1.1, 3)
NSS	Non-standard set-up	X100 0100	5.3.6.1.3, 3)
PID	Procedure interrupt disconnect	X011 0110	C.3.4, 2)
PIN	Procedure interrupt negative	X011 0100	5.3.6.1.7, 5)
PIP	Procedure interrupt positive	X011 0101	5.3.6.1.7, 4)
PPS	Partial page signal	X111 1101	A.4.3, 1)
PPR	Partial page request	X011 1101	A.4.4, 1)
PRI-EOM	Procedure interrupt-EOM	X111 1001	5.3.6.1.6, 4)
PRI-EOP	Procedure interrupt-EOP	X111 1100	5.3.6.1.6, 6)
PRI-MPS	Procedure interrupt-MPS	X111 1010	5.3.6.1.6, 5)
PWD	Password (for polling)	1000 0011	5.3.6.1.2, 4)
PWD	Password (for transmission)	X100 0101	5.3.6.1.3, 5)
RCP	Return to control for partial page	0110 0001	A.2.2
RNR	Receive not ready	X011 0111	A.4.4, 2)
RR	Receive ready	X111 0110	A.4.3, 3)
RTN	Retrain negative	X011 0010	5.3.6.1.7, 3)
RTP	Retrain positive	X011 0011	5.3.6.1.7, 2)
SEP	Selective polling	1000 0101	5.3.6.1.2, 5)
SUB	Subaddress	X100 0011	5.3.6.1.3, 4)
TCF	Training check	Zeros for 1.5 s	5.3.6.1.3, 6)
TSI	Transmitting subscriber identification	X100 0010	5.3.6.1.3, 2)

Appendix II

List of commands and appropriate responses

Commands	Comments	Appropriate responses
(NSF) (CSI) DIS	Identifying capabilities: from a manual receiver or an auto answer terminal	(NSC) (CIG) DTC (TSI) DCS (NSF) (CSI) DIS (CRP) (TSI) (NSS) (PWD) (SEP) (CIG) DTC (PWD) (SUB) (TSI) DCS
(NSC) (CIG) DTC	Mode setting command: from calling terminal	(TSI) DCS (NSF) (CSI) DIS (CRP) (TSI) (NSS)
(PWD) (SEP) (CIG) DTC	This is a poll operation	
(TSI) DCS (TSI) (NSS)	Mode setting command: from manual transmitter or automatic receiver	CFR FTT (NSC) (CIG) DTC (NSF) (CSI) DIS (CRP)
(PWD) (SUB) (TSI) DCS	This command is always followed by training	
CTC	Mode setting command: from the transmitter to the receiver	(CTR) (CRP)
(EOR-NULL)	Indicate the next block transmission from the transmitter to the receiver	(ERR) (RNR) (CRP)
(EOR-MPS) or (EOR-EOP) or (EOR-EOM) or (EOR-PRI-MPS) or (EOR-PRI-EOP) or (EOR-PRI-EOM)	Indicate the next message transmission from the transmitter to the receiver	(ERR) (RNR) PIN (CRP)
MPS or EOP or EOM or (PRI-MPS) or (PRI-EOP) or (PRI-EOM)	Post-message commands	MCF RTP RTN PIP PIN (CRP)
(PPS-NULL)	Post-message command for a partial page: from the transmitter to the receiver	(PPR) MCF (RNR) (CRP)
(PPS-MPS) or (PPS-EOP) or (PPS-EOM) or (PPS-PRI-MPS) or (PPS-PRI-EOP) or (PPS-PRI-EOM)	Post-message commands for a complete page: from the transmitter to the receiver	(PPR) MCF (RNR) PIP PIN (CRP)

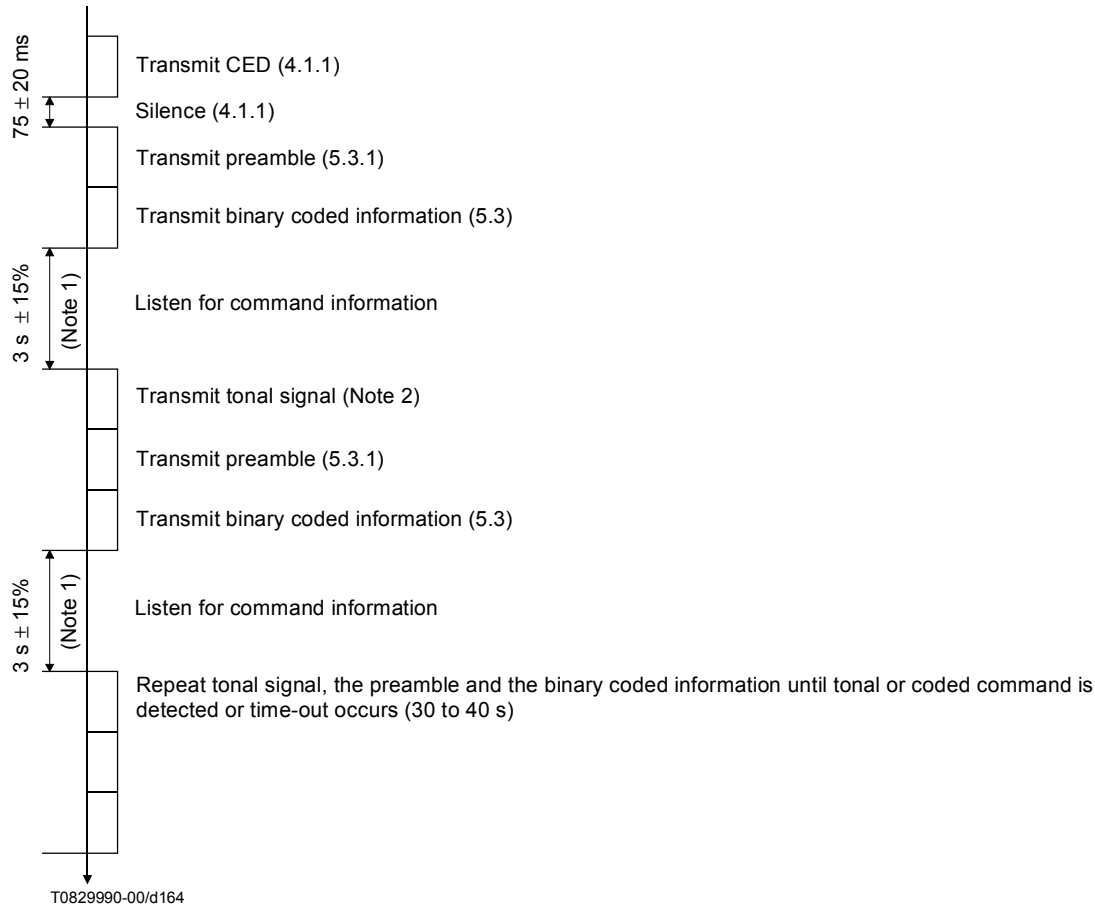
Commands	Comments	Appropriate responses
(RR)	Ask for the status of the receiver: from the transmitter to the receiver	(RNR) (ERR) MCF PIP PIN (CRP)
DCN	Phase E command	None
NOTE – Where the symbols () are used, the signals within these symbols are optional.		

Appendix III

Alternative procedures used by some terminals which conform to the pre-1996 versions of this Recommendation

III.1 Alternative automatic answering sequence

See Figure III.1.



NOTE 1 – For manual receivers using the binary coded procedure, this delay should be 4.5 s ± 15%.

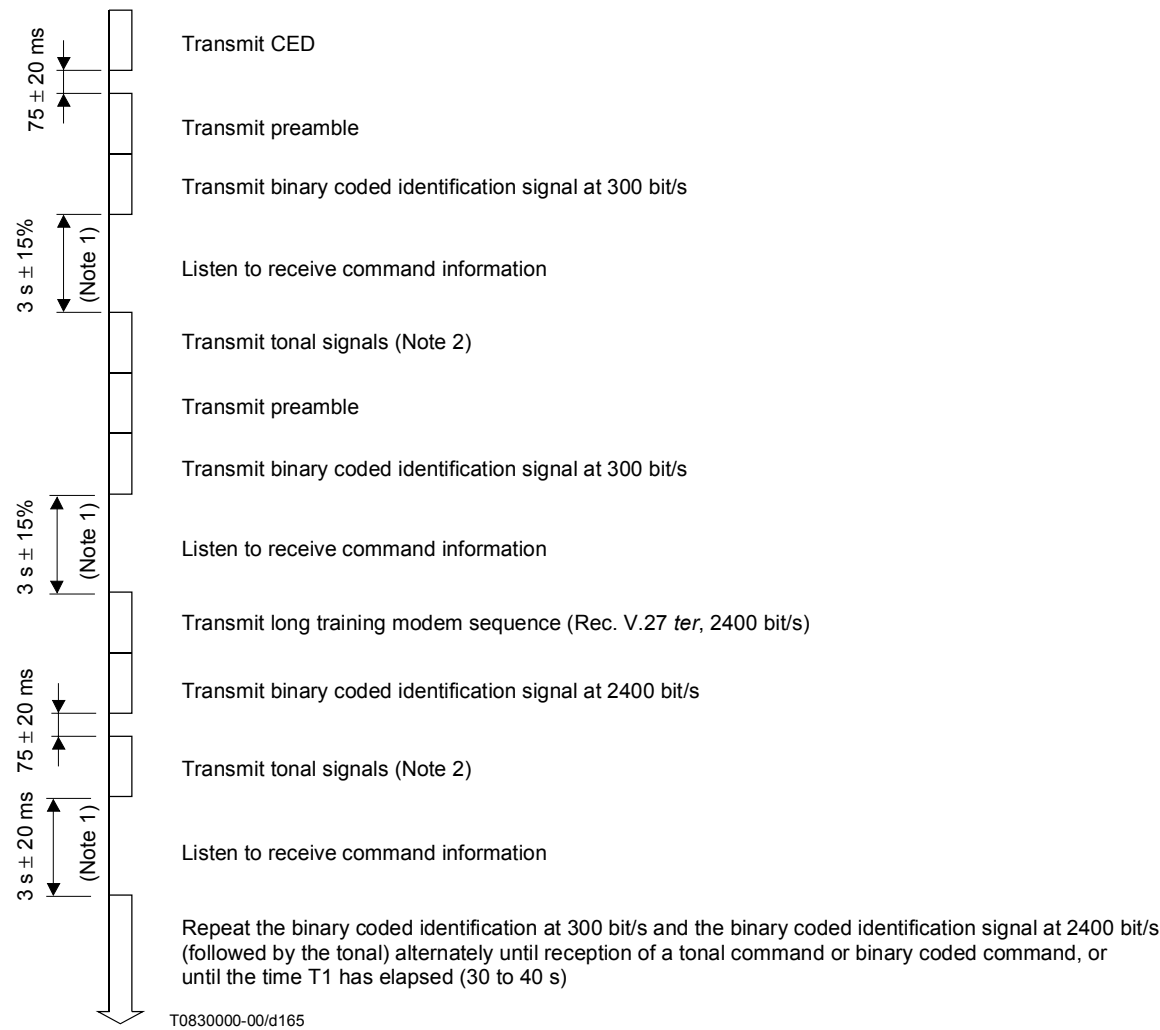
NOTE 2 – The tonal signal will have one of the following formats:

- a) 1650 Hz (±6 Hz) ON for 1.5 s and OFF for 3 s (timing tolerance ±15%); or
- b) 1850 Hz (±6 Hz) ON for 1.5 s and OFF for 3 s (timing tolerance ±15%); or
- c) 1650 Hz (±6 Hz) ON for 1.5 s immediately followed by 1850 Hz ON for 0.75 s followed by silence for 3 s (timing tolerance ±15%).

Figure III.1/T.30 – Called terminal procedures

III.2 Optional binary coded preamble

An example of a terminal having the standard binary coded, recognized optional binary coded and tonal capabilities is given in Figure III.2.



NOTE 1 – For manual receivers using the binary coded procedure, this delay should be 4.5 s ± 15%.

NOTE 2 – The tonal signal will have one of the following formats:

- a) 1650 Hz (±6 Hz) ON for 1.5 s and OFF for 3 s (timing tolerance ±15%); or
- b) 1850 Hz (±6 Hz) ON for 1.5 s and OFF for 3 s (timing tolerance ±15%); or
- c) 1650 Hz (±6 Hz) ON for 1.5 s immediately followed by 1850 Hz ON for 0.75 s followed by silence for 3 s (timing tolerance ±15%).

Figure III.2/T.30 – Called terminal procedures

Appendix IV

Signal sequence examples

The examples below are based on the flow diagrams and are for illustrative and instructional purpose only. They should not be interpreted as establishing or limiting the protocol. The exchange of the various commands and responses is limited only by the rules specified in this Recommendation (see 5.3 and 5.4).

The notations used in these diagrams are as follows:

- An arrowhead signifies the receiver of the signal.
- A solid line indicates transmission of the signal at the data rate of 300 bit/s.
- The dashed lines indicate transmission at the message data rate (ITU-T Recs V.27 *ter*, V.29 and V.17).
- A lightning bolt (↯) indicates an invalid frame.
- A bold solid line indicates the transmission of tonal signals.

In Figures IV.1 to IV.14 the examples given assume the DIS will be repeated for T1 seconds unless responded by a valid signal.

Example 1 An auto calling terminal wishing to transmit to an auto answer terminal: example of post-message commands.

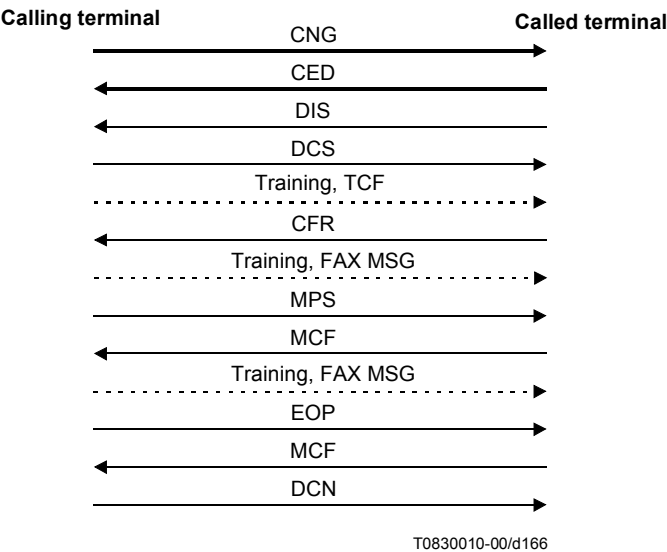


Figure IV.1/T.30

Example 2 A single page transmitter wishing to transmit to an auto answer terminal: example of EOM.

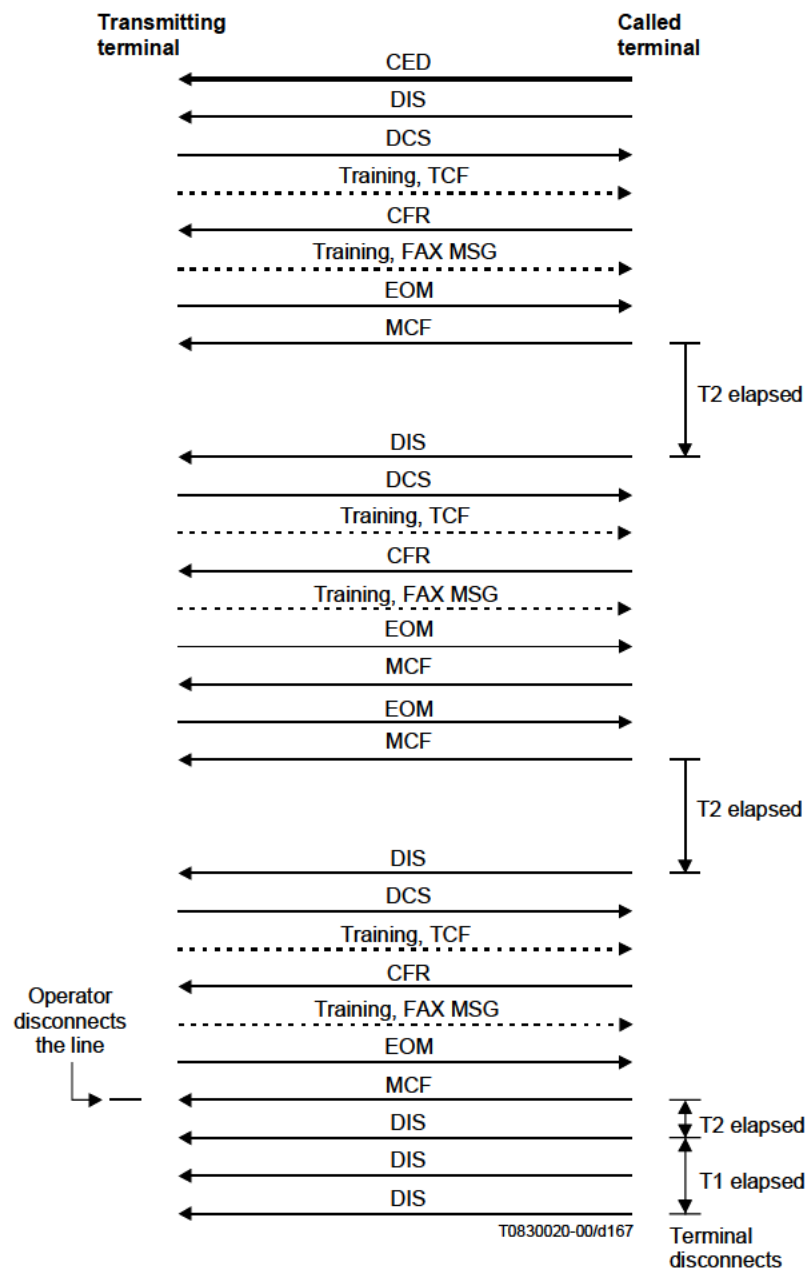


Figure IV.2/T.30

Example 3 An auto calling terminal wishing to transmit to an auto answer terminal: example of post-message responses.

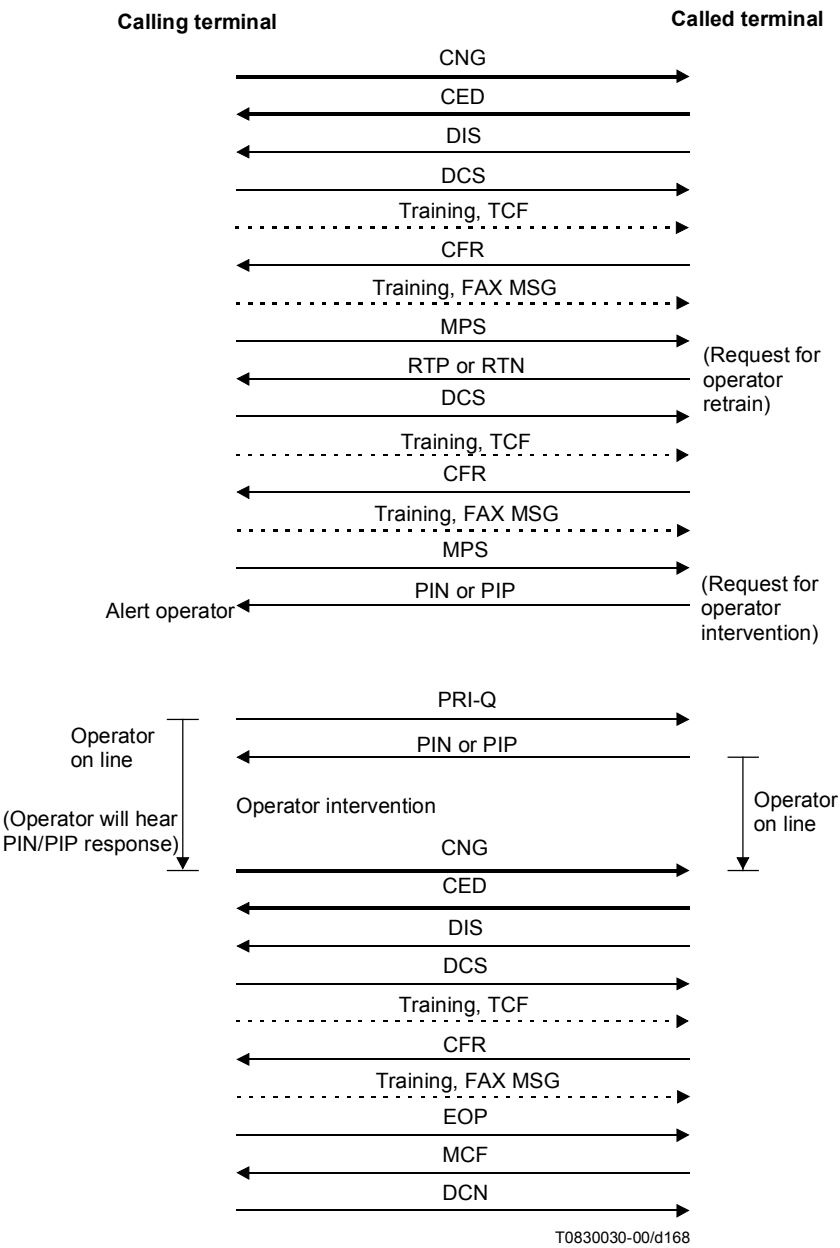


Figure IV.3/T.30

Example 4 Manual transmitter wishing to transmit to an auto answer terminal: example of initial training failure and procedural interrupts.

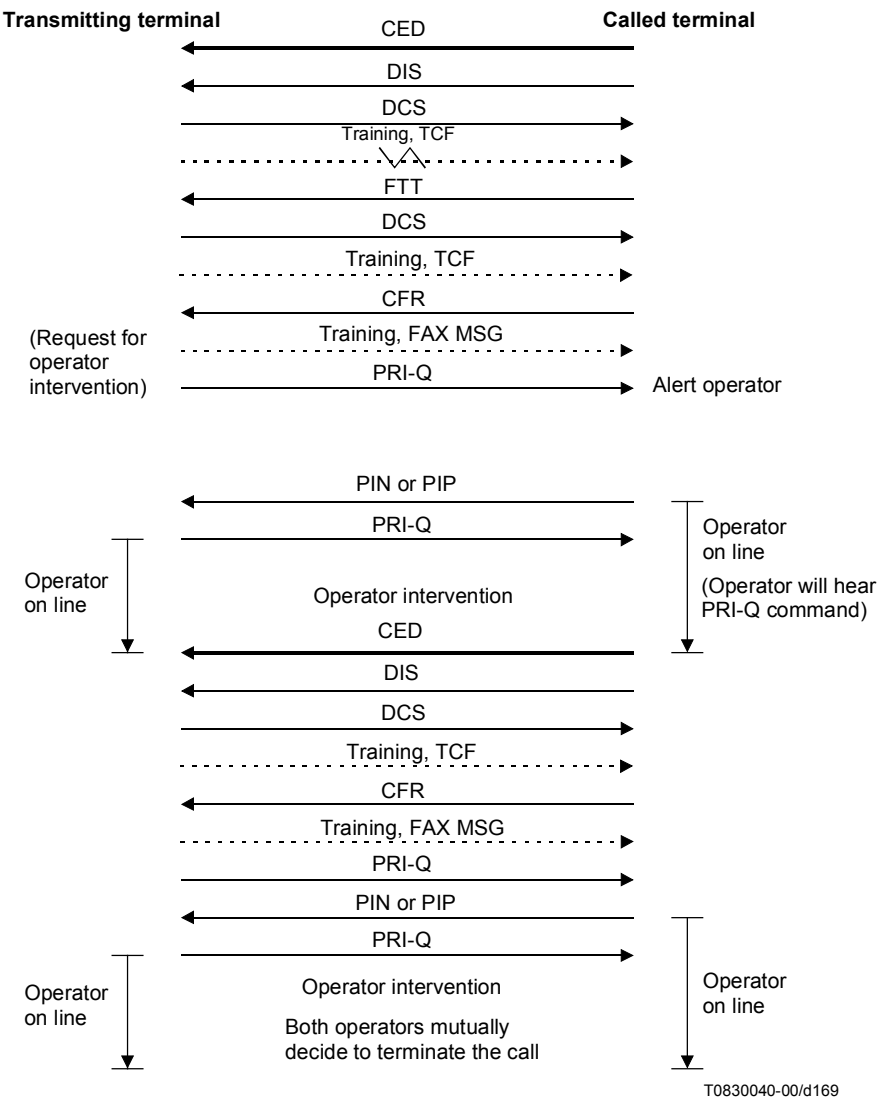


Figure IV.4/T.30

Example 5 Auto calling terminal wishing to first receive from, then transmit to, an auto answer terminal.

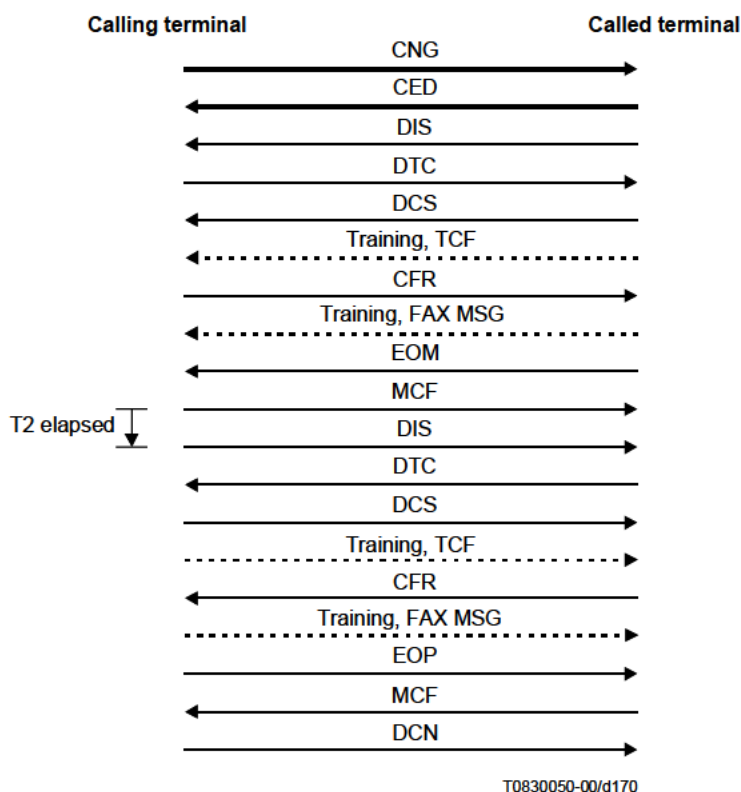


Figure IV.5/T.30

Example 6 Auto calling terminal wishing to receive from an auto answer terminal: example of polling and of optional as well as non-standard signals.

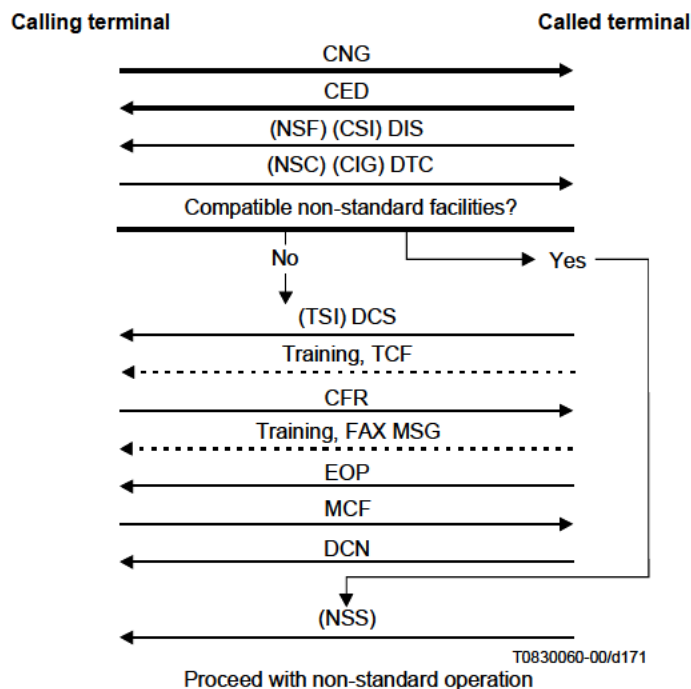


Figure IV.6/T.30

Example 7 An auto calling terminal wishing to transmit to an auto answer terminal: example of standard error recovery techniques.

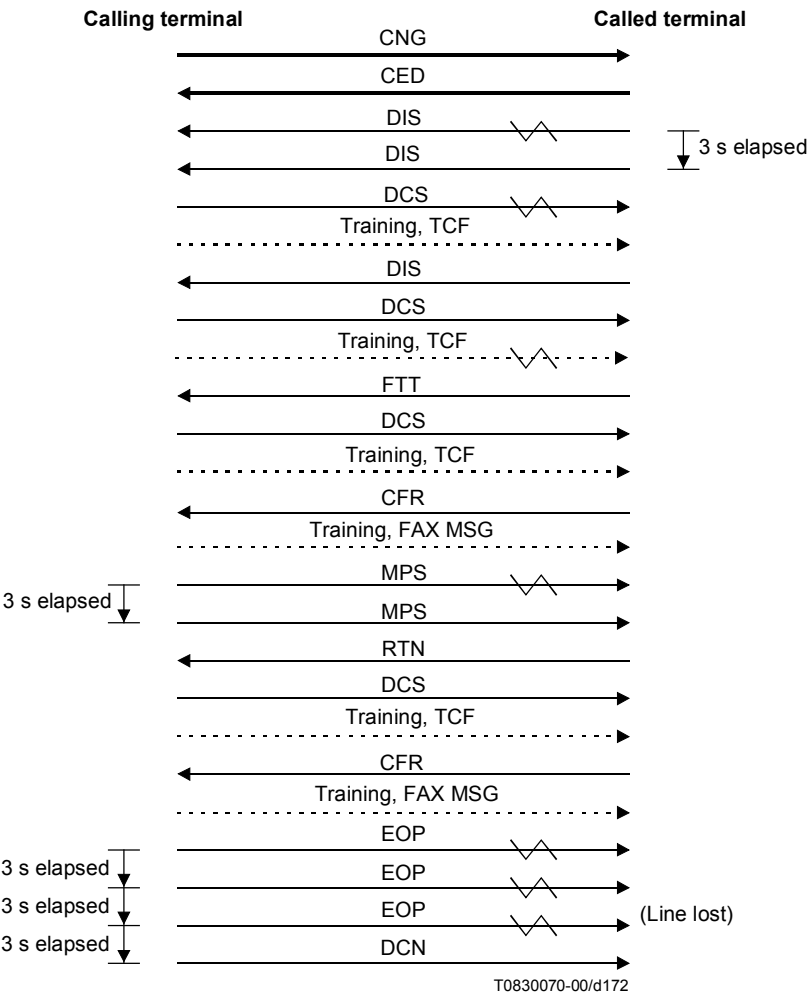


Figure IV.7/T.30

Example 8 Manual transmitter wishing to transmit to a manual receiver: example of error recovery technique using the optional CRP response.

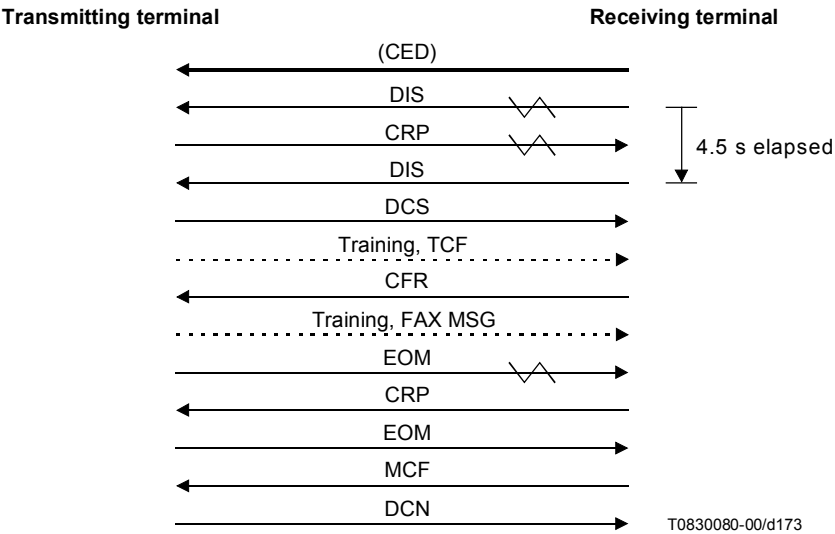


Figure IV.8/T.30

Example 9 An auto calling terminal wishing to receive from an auto answer terminal using password/selective polling capabilities.

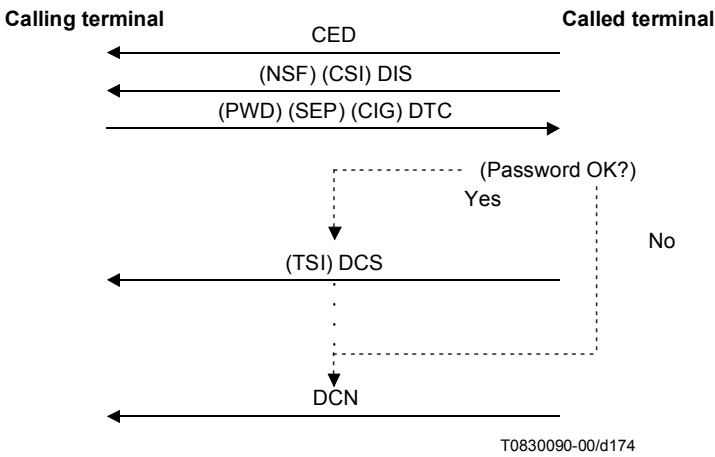


Figure IV.9/T.30

Example 10 An auto calling terminal wishing to transmit to an auto answer terminal using password/subaddress capabilities.

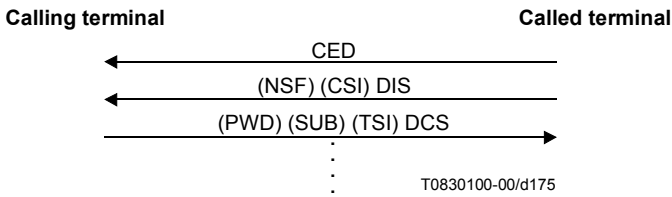


Figure IV.10/T.30

Example 11 Auto calling terminal wishing to first transmit to, then receive from an auto answer terminal.

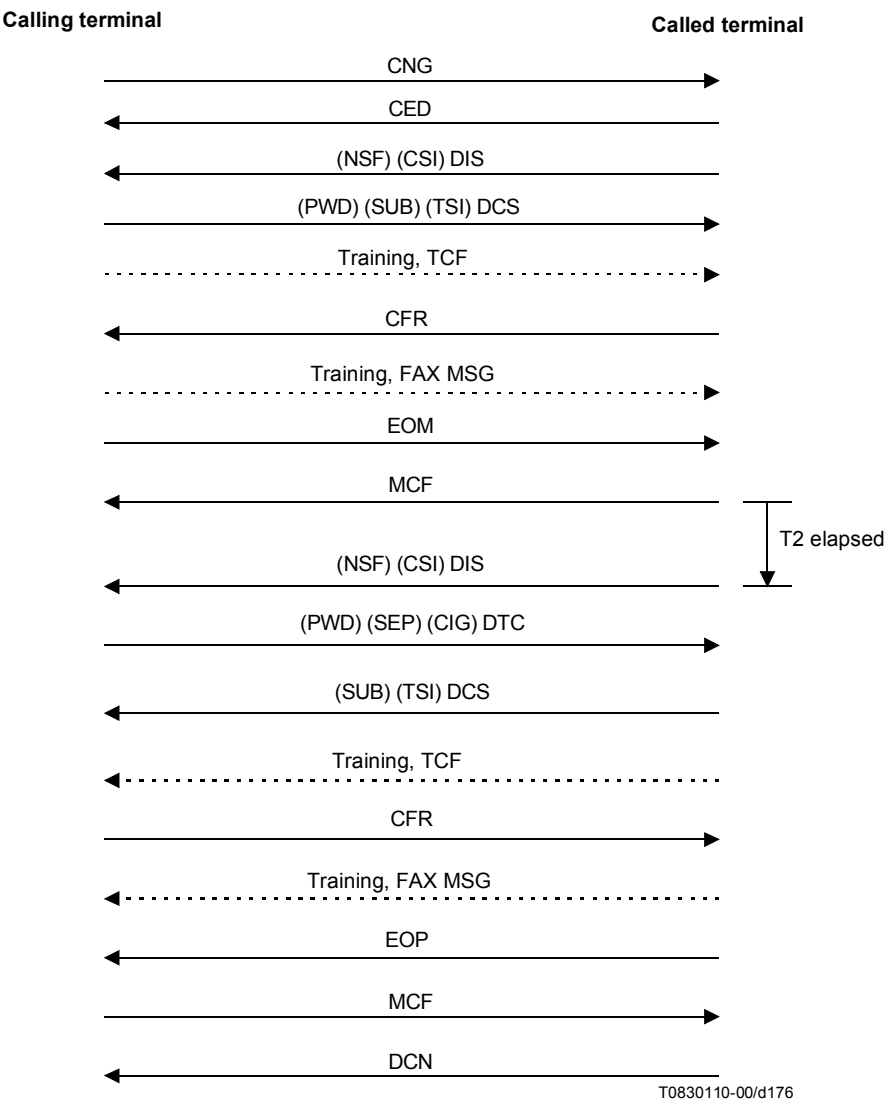
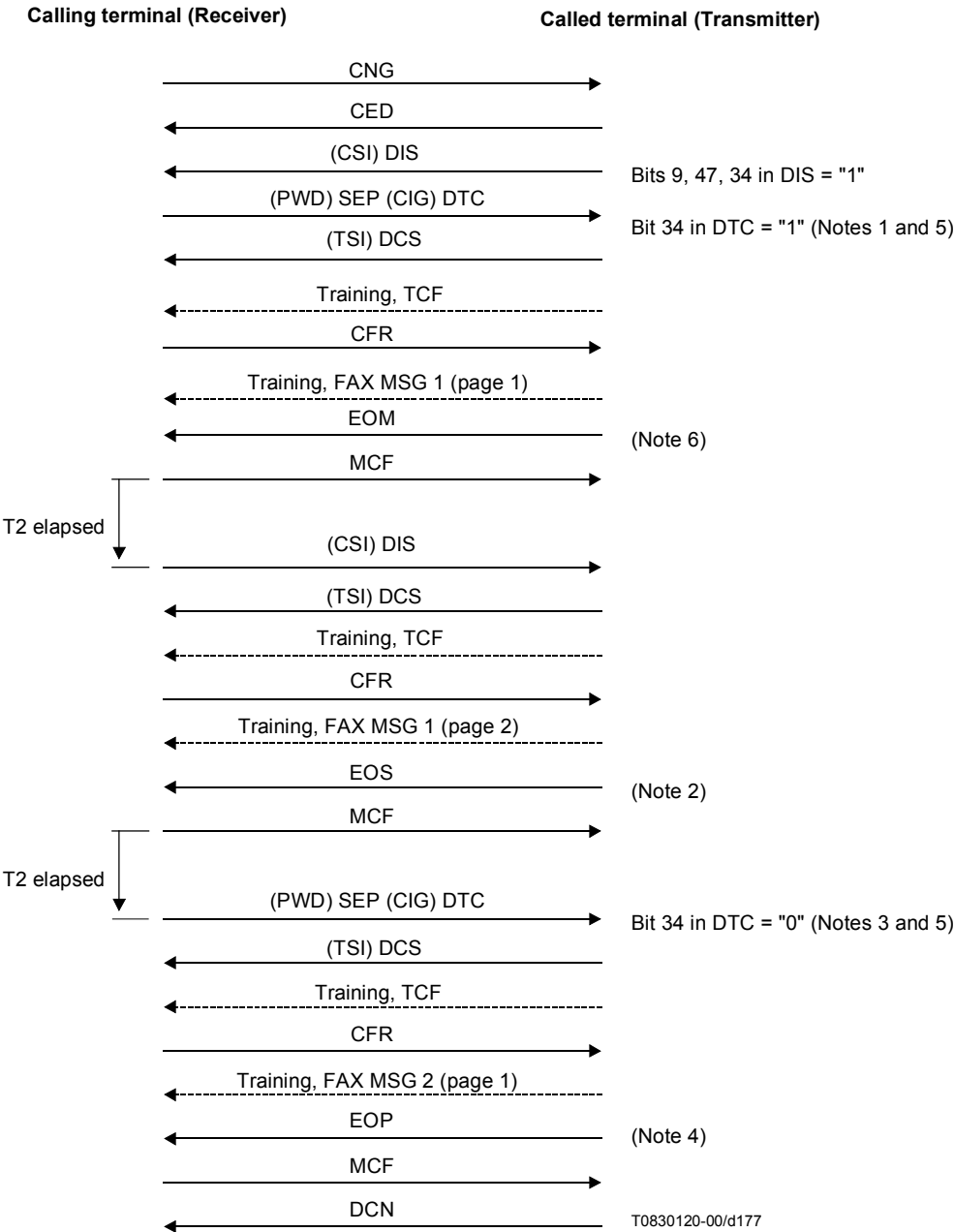


Figure IV.11/T.30

Example 12 Calling terminal wishing to receive multiple documents in one call.



NOTE 1 – Receiver sets bit 34 in DTC = "1" to indicate additional selection of document continues after current one.

NOTE 2 – Transmitter sends EOS to indicate the end of document to Receiver.

NOTE 3 – Receiver sets bit 34 in DTC = "0" to indicate no additional selection of documents continues after current one.

NOTE 4 – Transmitter sends EOP to indicate the end of current document and communication to Receiver.

NOTE 5 – Each FIF of PWD and SEP may be different.

NOTE 6 – Transmitter can send EOM to indicate the end of complete page of facsimile information and return to the beginning of Phase B.

Figure IV.12/T.30

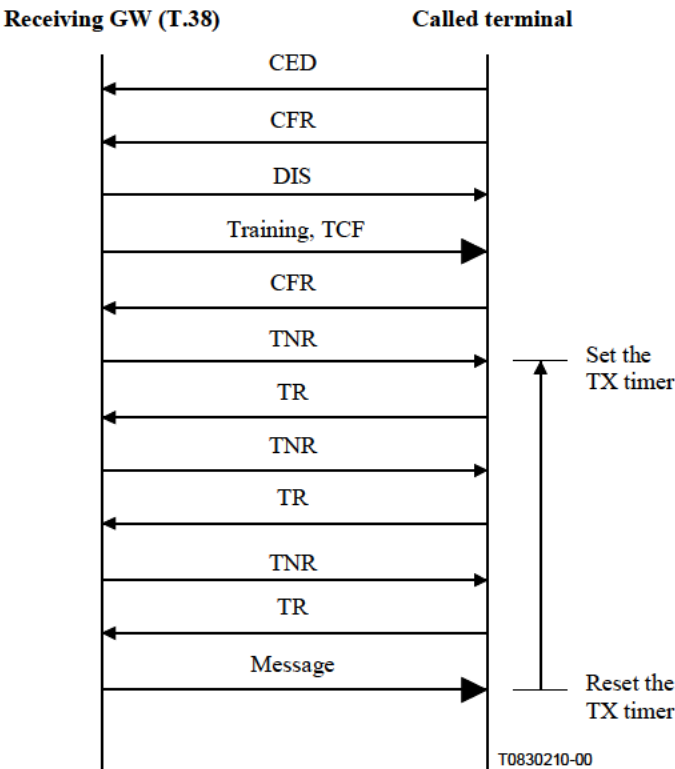


Figure IV.13/T.30

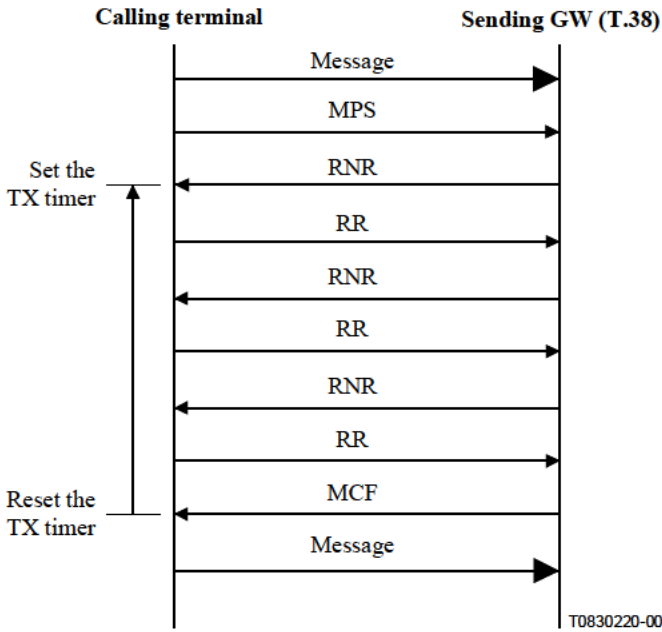


Figure IV.14/T.30

a) *Alternate mode with non-ECM*

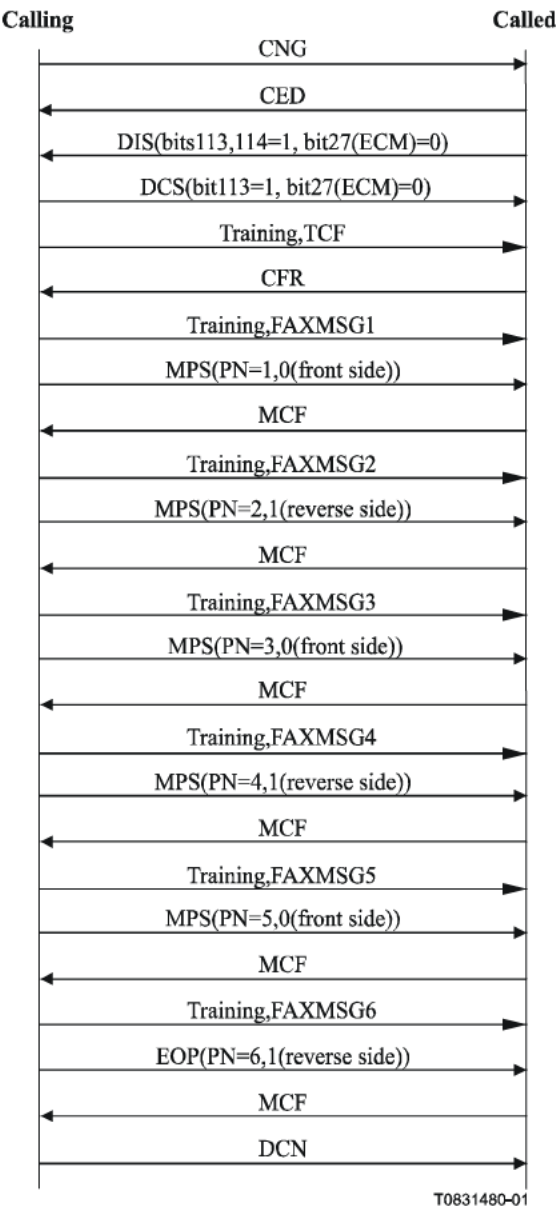


Figure IV.14-a/T.30

b) *Alternate mode with ECM*

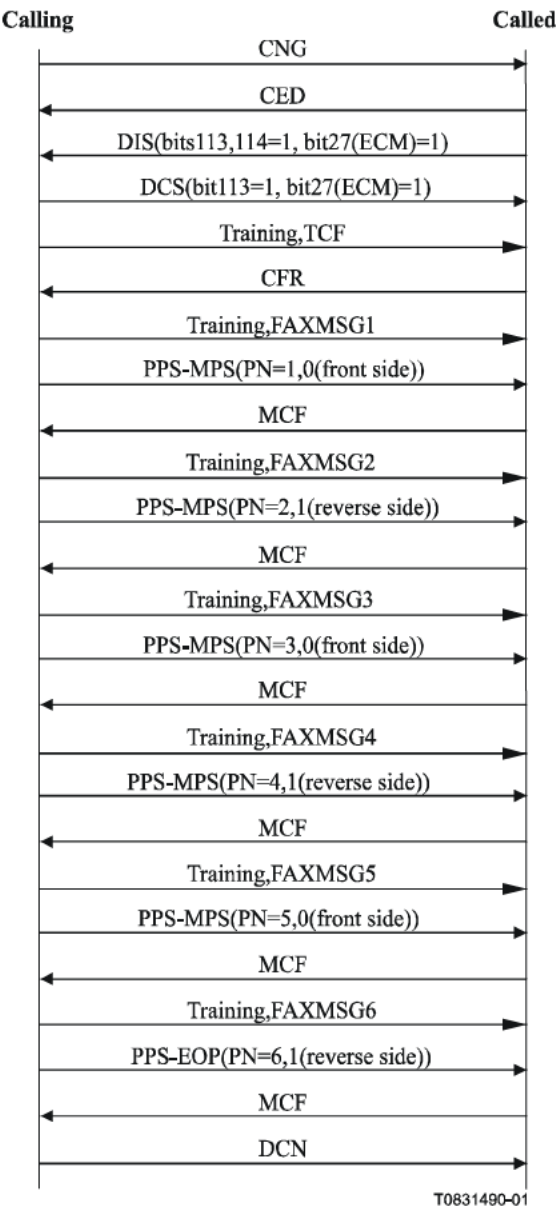


Figure IV.14-b/T.30

c) Continuous mode with non-ECM

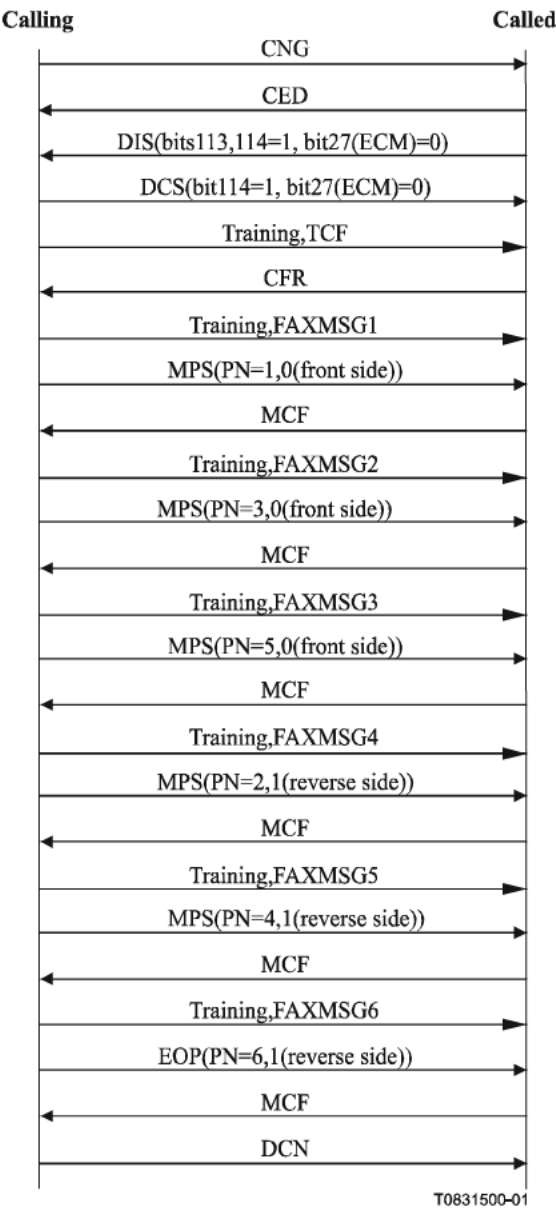


Figure IV.14-c/T.30

d) Continuous mode with ECM

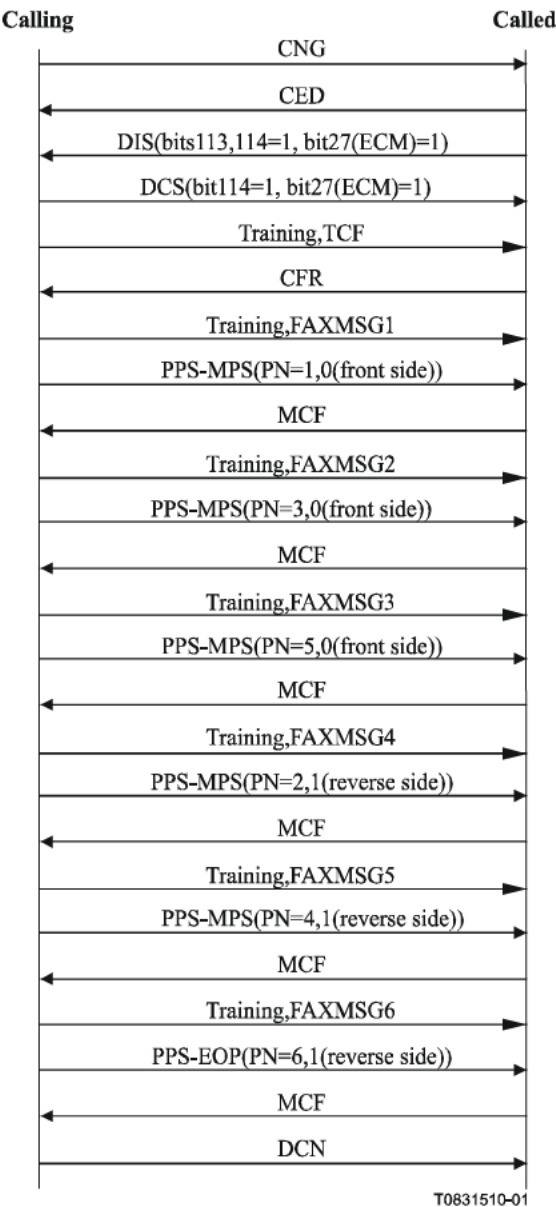


Figure IV.14-d/T.30

Appendix V

Procedure for binary file transmission with protocol examples

V.1 Introduction

This appendix describes the operation of the Binary File Transfer (BFT) protocol in the Group 3 facsimile mode of operation. Use of this protocol allows Group 3 facsimile terminal to interchange binary data files. Refer to ITU-T Rec. T.434 for information regarding the semantics and syntax of a binary encoded data file.

Facsimile terminals that wish to support this facility must support optional error correction mode of this Recommendation.

V.2 Definitions

V.2.1 attribute: A piece of information stating a property of something, taking one of a set of defined values, each value having a defined meaning.

V.2.2 binary file (data): A sequence of octets, representing a binary file and optional attributes, formed, using the coding rules in Appendix I/T.434.

V.2.3 file attributes: The name and other identifiable properties of a file.

V.2.4 real filestore: An organized collection of files, including their attributes and names, which reside on a real system.

V.2.5 virtual filestore: An abstract model for describing files and filestores, and the possible actions performed on them.

V.3 BFT file transfer-protocol overview

Group 3 terminals supporting BFT are capable of sending and receiving facsimile messages and binary data files in the same call establishment. This is accomplished by using Error Correction Mode (ECM) and sending the binary data as the logical equivalent of an error-corrected facsimile message.

The BFT option is indicated by the setting of a capability bit in the DIS/DTC frame. Bit 53 specifies the additional capability required by BFT.

The high-speed binary file data are formed using the coding rules in ITU-T Rec. T.434. These rules specify how to code the set of attributes as a sequence of octets. This binary data are then transmitted on the high-speed data channel using ECM.

Transmitting a binary file is logically equivalent to transmitting an error-corrected facsimile message (with one or more pages). In fact, multiple binary files may be contained within the logical equivalent of an error-corrected facsimile message. At any point during the transmission, the transmitter may request a diagnostic message from the receiver by suspending the current transfer with a PPS post-message command. At this point the receiver may optionally respond with a diagnostic message. Transfer of the current binary file(s) will continue on the next page. The first octet of this new page will be the next unsent octet of the binary file data.

Other protocol considerations for BFT can be found in Annex C/T.4.

V.4 ECM-BFT data format

The high-speed ECM-BFT binary data are a set of contiguous octets defined in ITU-T Rec. T.434. Using Group 3 facsimile terminal, this set of octets is transmitted as an ECM message. Within an ECM page, these octets are segmented into blocks and into the HDLC frames. This segmentation is completely independent of attribute boundaries. A sequence of octets is transmitted beginning with the least significant bit in the first octet.

The ECM-BFT binary data format allows the following combinations of binary data and ECM pages. Cases a) and d) where each binary file corresponds to a single ECM page are the preferred formats.

- a) a single binary file in a single ECM page;
- b) a single binary file in a multiple of ECM pages;
- c) multiple binary files in a single ECM page;
- d) multiple binary files in a multiple of ECM pages.

V.5 Simple BFT negotiation via Phase C method

Session examples for the Simple Phase C BFT method are provided. The examples below are based on flow diagrams and are for illustrative and instruction purposes only. They should not be interpreted as establishing or limiting the protocol.

V.5.1 Clause V.4 case a) examples

V.5.1.1 A transmitted file is acceptable on a receiver. See Figure V.1.

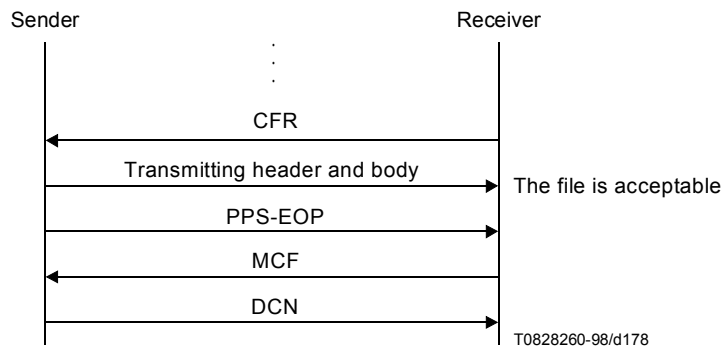


Figure V.1/T.30 – Transmitted file acceptable on a receiver

A sender transmits header and body as the first ECM page. (PPS-NULL is transmitted in case of more than one ECM page data.) As a receiver recognizes that the file is acceptable from the header, it transmits MCF.

V.5.1.2 A transmitted file is processed on a sender. See Figure V.2.

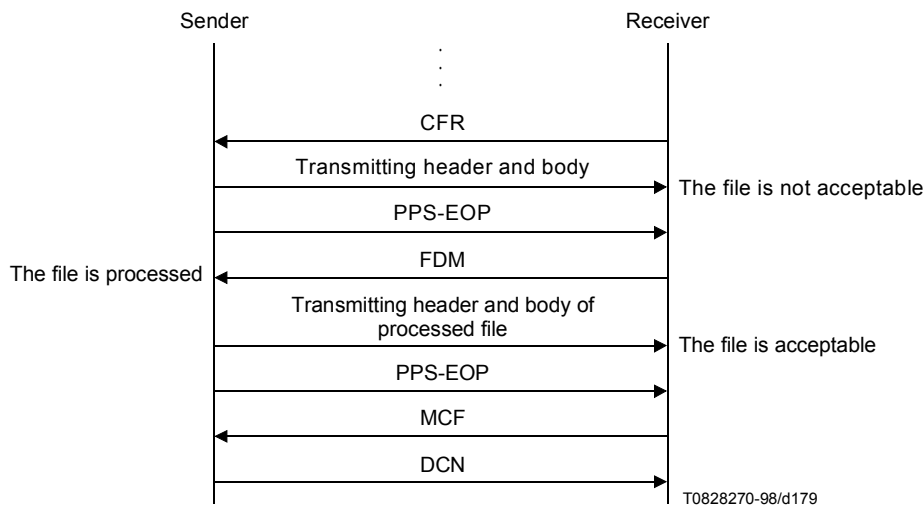


Figure V.2/T.30 – Transmitted file processed on a sender

A sender transmits header and body as the first ECM page. As a receiver recognizes that the file is not acceptable from the header, it transmits FDM and notifies the sender with the diagnostic message. The sender processes the file from the content of FDM and transmits header and body of the processed file as the next ECM page.

V.5.1.3 A transmitted file is not processed on a sender. See Figure V.3.

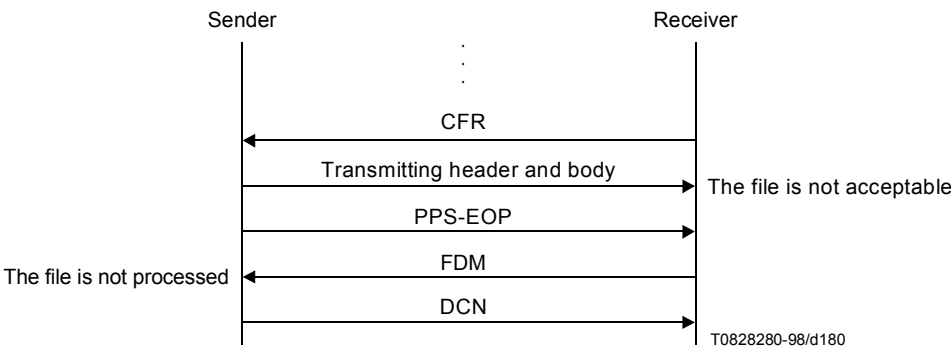


Figure V.3/T.30 – Transmitted file not processed on a sender

A sender transmits header and body as the first ECM page. As a receiver recognizes that the file is not acceptable from the header, it transmits FDM and notifies the sender of the diagnostic message. When the sender does not process the file from the content of FDM, it transmits DCN.

V.5.2 Clause V.4 case b) examples

V.5.2.1 A transmitted file is acceptable on a receiver. See Figure V.4.

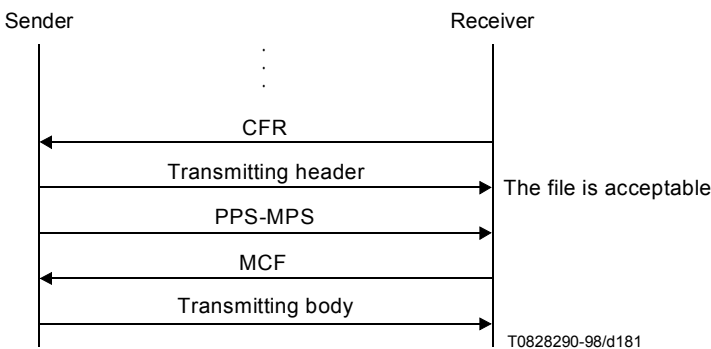


Figure V.4/T.30 – Transmitted file acceptable on a receiver

A sender transmits header as the first ECM page. As a receiver recognizes that the file is acceptable from the header, it transmits MCF. The sender transmits body as the next ECM page.

V.5.2.2 A transmitted file is processed on a sender. See Figure V.5.

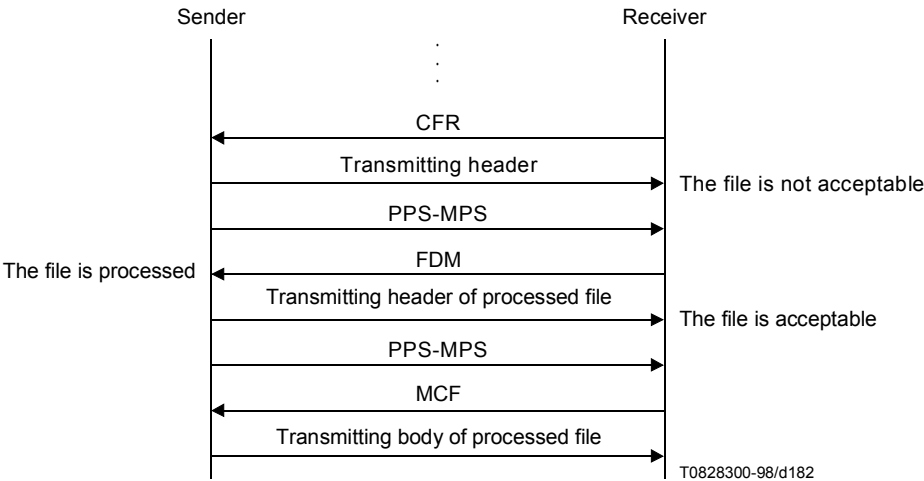


Figure V.5/T.30 – Transmitted file processed on a sender

A sender transmits header as the first ECM page. As a receiver recognizes that the file is not acceptable from the header, it transmits FDM and notifies the sender of the diagnostic message. The sender processes the file from the content of FDM and transmits header of the processed file as the next ECM page. The receiver transmits MCF and the sender transmits body of the processed file as the next ECM page.

V.5.2.3 A transmitted file is not processed on a sender. See Figure V.6.

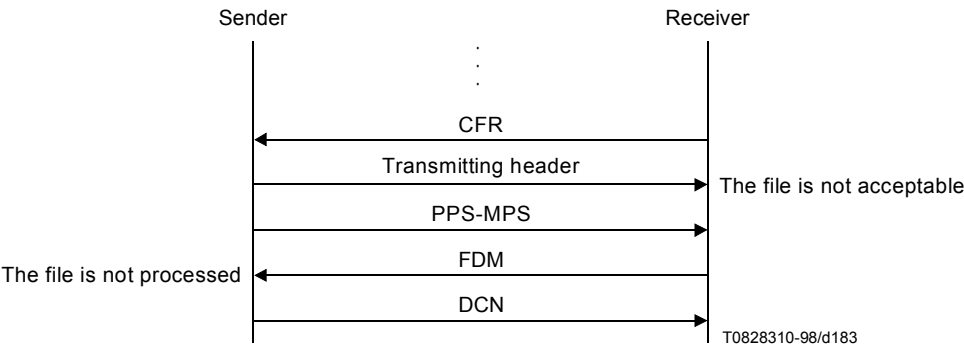


Figure V.6/T.30 – Transmitted file not processed on a sender

A sender transmits header as the first ECM page. As a receiver recognizes that the file is not acceptable from the header, it transmits FDM and notifies the sender of the diagnostic message. When the sender does not process the file from the content of FDM, it transmits DCN.

V.6 Extended BFT Negotiation via Phase B Method

Session examples for the Extended Phase B BFT method are provided. The examples below are based on flow diagrams and are for illustrative and instruction purposes only. They should not be interpreted as establishing or limiting the protocol.

V.6.1 Identification of BFT Capabilities followed by BFT File Transfer Negotiations (Selection of extended negotiations via V.8)

Originator		Called Terminal	
BFT Transfer Request	DEC	<-----	DES Identify BFT Capabilities
		----->	
BFT Message		<-----	CFR Accept BFT
		----->	Transfer Request
PPS-EOP		<-----	MCF
		----->	DCN

V.6.2 BFT File Transfer Negotiations in Phase B – Request rejected (Selection of extended negotiations via V.8)

Originator		Called Terminal	
BFT Transfer Request	DEC	<-----	DES Identify BFT Capabilities
		----->	
Revise BFT Transfer Request	DEC	<-----	FNV Reject File Transfer Request
		----->	
BFT Message		<-----	CFR
		----->	
PPS-EOP		<-----	MCF
		----->	DCN

V.6.3 BFT File Transfer Request via Phase B (Single Step Indirect Entry)

Originator		Called Terminal	
BFT Transfer Request	DEC	<-----	DIS Extended BFT negs bit set
		----->	
BFT Message		<-----	CFR
		----->	
PPS-EOP		<-----	MCF
		----->	DCN

V.6.4 BFT Capability Identification and File Transfer Request via Phase B (Indirect Entry)

Originator		Called Terminal	
Request Extended Capabilities	DER	<-----	DIS Extended BFT negs bit set
		----->	
BFT Transfer Request	DEC	<-----	DES I Identify BFT Capabilities
		----->	
Revise BFT Transfer Request	DEC	<-----	FNV Reject File Transfer Request
		----->	
BFT Message		<-----	CFR Accept BFT Transfer Request
		----->	
PPS-EOP		<-----	MCF
		----->	DCN

Sample Coding Example for this case:

Syntax of tag encoded data of first DER::=<Encapsulated Frame SG><SG Length><FIF of TSI Group><Group Length><TSI value>

Syntax of tag encoded data of DES response::=<BFT Negotiations SG><SG Length><File Types Group><Group Length><Sequence of Filetypes><Compression Types Group><Group Length><Sequence of Compression Types>

Syntax of tag encoded data of DEC used for BFT Transfer Request::=<BFT Negotiations SG><SG Length><Transfer Request Group><Group Length><BFT tags for T.434 Binary Data Message>

Appendix VI

Mixed Raster Content examples

The following examples illustrate how the various image parameters may be combined and changed between strips and pages as a function of the DIS/DTC and DCS negotiations as defined in J.6. The relevant DIS/DTC and DCS bit definitions, per Table 2, are provided below:

Bit	Definition	Bit	Definition
15	200 × 200 pels/25.4 mm	16	Two-dimensional coding
31	T.6 coding	36	T.43 coding
98	100 × 100 pels/25.4 mm	42	300 × 300 pels/25.4 mm
43	400 × 400 pels/25.4 mm	68	JPEG coding
71	12 bits/pel component	73	No subsampling (1:1:1)
74	Custom illuminant	75	Custom gamut range
78	Single-progression sequential coding (ITU-T Rec. T.85)		

Bits 92, 93, 94 T.44 (MRC) Mode Definition
(1,0,0) Base mode (Mode 1)
(0,1,0) Extended Mode beyond three layers (Mode 2)

- a) In the example below, MMR (ITU-T Rec. T.6) and MH (ITU-T Rec. T.4, 1-D base mode) are the available bi-level coders. Switching between these two mask coders occurs on page boundary, the specific coder being used is identified in the Start of Page Marker Segment (SOP MS). JPEG and ITU-T Rec. T.43 are the available multilevel coders. JPEG or ITU-T Rec. T.43 may be used in either the background or foreground, switching between these two coders occurs on stripe boundary. Identification occurs in the data stream. The coders are made available for both layers by their identification in the SOP MS. Resolutions of 400 × 400 and 200 × 200 pels/25.4 mm are available for the mask layer. Switching between these two mask resolutions occurs on page boundary, the specific resolution being used is identified in the Start of Page Marker Segment (SOP MS). Resolutions of 400 × 400, 200 × 200 and 100 × 100 pels/25.4 mm or 200 × 200 and 100 × 100 pels/25.4 mm are available for the background and foreground layers when the mask resolution is 400 × 400 or 200 × 200 pels/25.4 mm respectively. Switching between these background and foreground resolutions occurs on stripe boundary. Identification occurs in the data stream. Only default colour resolution, subsampling, illuminant and gamut are available for the background and foreground layers.

Bits	15	16	31	36	98	42	43	68	71	73	74	75	78
DIS	1	1	1	1	1	1	1	1	1	1	1	1	1
DCS	1	0	1	1	1	0	1	1	0	0	0	0	0

	Coder	Spatial resolution	Colour resolution	Subsampling	Illuminant	Gamut
Page 1 stripe 1						
Mask	MMR	400	na	na	na	na
Background	ITU-T Rec. T.42	200	≤ 8 bpc	(4:1:1)	D50	Default
Foreground	ITU-T Rec. T.43	100	≤ 8 bpc	(4:1:1)	D50	Default
Page 1 stripe 2						
Mask	MMR	400	na	na	na	na
Background	ITU-T Rec. T.43	200	≤ 8 bpc	(4:1:1)	D50	Default
Foreground	ITU-T Rec. T.43	200	≤ 8 bpc	(4:1:1)	D50	Default
Page 1 stripe 3						
Mask	MMR	400	na	na	na	na
Background	ITU-T Rec. T.43	400	≤ 8 bpc	(4:1:1)	D50	Default
Foreground	ITU-T Rec. T.42	100	≤ 8 bpc	(4:1:1)	D50	Default
Page 2 stripe 1						
Mask	MH	200	na	na	na	na
Background	ITU-T Rec. T.43	100	≤ 8 bpc	(4:1:1)	D50	Default
Foreground	ITU-T Rec. T.42	200	≤ 8 bpc	(4:1:1)	D50	Default

- b) In the example below, JBIG (ITU-T Rec. T.85), MMR (ITU-T Rec. T.6) and MH (ITU-T Rec. T.4, 1-D base mode) are the available bi-level coders. Switching between these three mask coders occurs on page boundary; the specific coder being used is identified in the Start of Page Marker Segment (SOP MS). JPEG is the available multilevel coder. JPEG is used in both the background or foreground. The coder is made available for both layers by its identification in the SOP MS. Resolution of 300×300 pels/25.4 mm is available for the mask layer, it is identified in the Start of Page Marker Segment (SOP MS). Resolutions of 300×300 and 100×100 pels/25.4 mm are available for the background and foreground layers. Switching between these two background and foreground resolutions occurs on stripe boundary. Identification occurs in the data stream. Switching between the two available colour resolutions (8 or 12 bits/component) and the two subsamplings (4:1:1 or 1:1:1) in the background and foreground occurs on stripe boundary. Identification occurs in the data stream. Only default illuminant and gamut are available for the background and foreground layers.

Bits	15	16	31	36	98	42	43	68	71	73	74	75	78
DIS	1	1	1	1	1	1	1	1	1	1	1	1	1
DCS	0	0	1	0	1	1	0	1	1	1	0	0	1

	Coder	Spatial resolution	Colour resolution	Subsampling	Illuminant	Gamut
Page 1 stripe 1						
Mask	MMR	300	na	na	na	na
Background	ITU-T Rec. T.42	300 100	≤ 12 bpc	(1:1:1)	D50	Default
Foreground	ITU-T Rec. T.42	100 100	≤ 8 bpc	(4:1:1)	D50	Default
Page 1 stripe 2						
Mask	MMR	300	na	na	na	na
Background	ITU-T Rec. T.42	300 100	≤ 8 bpc	(4:1:1)	D50	Default
Foreground	ITU-T Rec. T.42	300 100	≤ 8 bpc	(4:1:1)	D50	Default
Page 2 stripe 1						
Mask	JBIG	300	na	na	na	na
Background	ITU-T Rec. T.42	100 100	≤ 12 bpc	(4:1:1)	D50	Default
Foreground	ITU-T Rec. T.42	100 100	≤ 12 bpc	(1:1:1)	D50	Default
Page 3 stripe 1						
Mask	MH	300	na	na	na	na
Background	ITU-T Rec. T.42	100 100	≤ 8 bpc	(4:1:1)	D50	Default
Foreground	ITU-T Rec. T.42	100 100	≤ 8 bpc	(4:1:1)	D50	Default

- c) In the example below, MR (ITU-T Rec. T.4, 2-D) and MH (ITU-T Rec. T.4, 1-D base mode) are the available bi-level coders. Switching between these two mask coders occurs on page boundary, the specific coder being used is identified in the Start of Page Marker Segment (SOP MS). JPEG and ITU-T Rec. T.43 are the available multilevel coders. JPEG or ITU-T Rec. T.43 may be used in either the background or foreground; switching between these two coders occurs on stripe boundary. Identification occurs in the data stream. The coders are made available for both layers by their identification in the SOP MS. Resolution of 200×200 pels/25.4 mm is available for the mask layer, it is identified in the Start of Page Marker Segment (SOP MS). Resolutions of 200×200 and 100×100 pels/25.4 mm are available for the background and foreground layers. Switching between these background and foreground resolutions occurs on stripe boundary. Identification occurs in the data stream. Switching between the two available colour resolutions (8 or 12 bits/component) and the two subsamplings (4:1:1 or 1:1:1) in the background and foreground occurs on stripe boundary. Identification occurs in the data stream. Custom and default illuminant and gamut are available for the background and foreground layers. Switching between custom and default illuminant and gamut in the background and foreground occurs on stripe boundary. Identification occurs in the data stream.

Bits	15	16	31	36	98	42	43	68	71	73	74	75	78
DIS	1	1	1	1	1	1	1	1	1	1	1	1	1
DCS	1	1	0	1	1	0	0	1	0	1	1	1	1

	Coder	Spatial Resolution	Colour Resolution	Subsampling	Illuminant	Gamut
Page 1 stripe 1						
Mask	MH	200	na	na	na	na
Background	ITU-T Rec. T.42	200	≤ 8 bpc	(1:1:1)	Custom	Custom
Foreground	ITU-T Rec. T.43	100	≤ 8 bpc	(4:1:1)	D50	Default
Page 1 stripe 2						
Mask	MH	200	na	na	na	na
Background	ITU-T Rec. T.43	200	≤ 8 bpc	(1:1:1)	D50	Custom
Foreground	ITU-T Rec. T.43	100	≤ 8 bpc	(4:1:1)	Custom	Default
Page 2 stripe 1						
Mask	MR	200	na	na	na	na
Background	ITU-T Rec. T.42	100	≤ 8 bpc	(1:1:1)	D50	Default
Foreground	ITU-T Rec. T.43	100	≤ 8 bpc	(4:1:1)	D50	Default

Appendix VII

Application rules for use of V.8 with Group 3 facsimile

VII.1 Introduction

ITU-T Rec. V.8 is used to identify the capabilities and select the modes of operation of modems whose application and requirements vary. Confusion may occur if two facsimile terminals try to connect using V.8. If V.34 is not a mutual mode, then applying the rules of modulation selection as specified in V.8 may result in V.17, V.29 or V.27 *ter* being selected as the highest common modulation for Sig C and Sig A. This is not what is desired for Group 3 Facsimile, since the correct Sig A is V.21 channel 2. This appendix provides guidance on how to use and interpret V.8 to avoid the incorrect selection of modulation.

VII.2 Application rules

The basis of these procedures is to use the V.8 Call Function octets to determine the proper interpretation of the Modulation codepoints. The following procedures are recommended.

VII.2.1 Calling procedure

When transmitting CM the calling terminal sets the required facsimile Call Function, and its supported modulation codepoints should be identified.

VII.2.2 Answering procedure

The answering terminal responds in the JM sequence by indicating in the Call Function octet that it is also a facsimile terminal and identifies its common modulations by setting the appropriate codepoints.

VII.2.3 Decision procedure

If the agreed Call Function is a facsimile transaction, and the highest common modulation selected by the terminals is either V.17, V.29 or V.27 *ter*, then upon completion of the V.8 negotiation the answering modem conditions its transmitter and the calling modem its receiver for V.21 Channel 2. The terminals continue with the procedures as defined in clause 5.

NOTE – While the interpretation of the modulation bits for non-facsimile terminal applications is beyond the scope of this appendix, it is suggested the modulation bits be interpreted literally.

Appendix VIII

Examples for Internet routing/polling

NOTE – Signals indicated in parenthesis are optional.

VIII.1 Internet routing using email fax through onramp and offramp gateways

Table VIII.1/T.30 – Phase 1: Calling facsimile terminal to the onramp gateway communication via T.30

Calling terminal	Onramp gateway
<ol style="list-style-type: none"> 1) Traditional facsimile user sets document in standard facsimile terminal with IRA option. 2) Facsimile user introduces the international telephone number of the designated terminal to IRA. e.g., IRA: +41 1234 5678 Alternatively an Email address of the designated terminal (PC email client, Internet aware facsimile terminal or standard facsimile terminal with optional Internet Address Exchange Protocol), e.g., ifax@ties.itu.int can be used, which is not applicable to this example. 3) Facsimile user introduces optional additional information for the called destination: (SUB) e.g., SUB:130 (SID) 4) Facsimile user selects Internet Provider or accepts the pre-set one (local function). 5) Facsimile user starts terminal. Terminal detects dial tone and dials telephone number of the gateway. 	<ol style="list-style-type: none"> 6) Gateway detects ring and answers the call Transmit CED/Begin facsimile procedure 7) (Transmit CSI) Transmit DIS with IRA-bit set; optional SUB- and SID-bits set.

Table VIII.1/T.30 – Phase 1: Calling facsimile terminal to the onramp gateway communication via T.30

Calling terminal	Onramp gateway
8) DIS detected 9) (Transmit TSI) (Transmit SUB:130) (Transmit SID) Transmit IRA: +41 1234 5678 Transmit DCS with IRA(/SUB/SID)-bit(s) set 10) Continue with normal facsimile procedure (transmit fax message) 13) Receive in Phase D confirmation from the onramp gateway 14) Switch back to telephone.	 11) Continue with normal facsimile procedure (receive fax message) 12) Send Phase D confirmation to the calling facsimile terminal. 15) Switch back to telephone.

Table VIII.2/T.30 – Phase 2: Onramp gateway to offramp gateway communication via T.37

Onramp gateway	Offramp gateway/Internet aware facsimile terminal
1) Communicate in T.37 mode of operation; map relevant information where applicable: IRA(/SUB) → Email address conforms to RFC 2304 e.g., IRA: +41 1234 5678, SUB:130 are designated by facsimile user, then email address is FAX=+4112345678/T33S=130@faxworld.org where the domain name "faxworld.org" is generated in the onramp gateway by the appropriate method, and the method is outside the scope of this appendix. Information from the following signals may be used for access or authentication purposes locally at the onramp gateway: (TSI) (SID)	2) Communicate in T.37 mode of operation; receive left hand side of email address.: Left hand side of email address → Phone number to be dialled: +41 1234 5678 // (SUB:130)

**Table VIII.3/T.30 – Phase 3: Offramp gateway communication
to the called facsimile terminal via T.30**

Offramp gateway	Called facsimile terminal
1) Gateway switches to line. Gateway detects dial tone, takes telephone number: +41 1234 5678 from left hand side of email address and dials this number. 4) DIS detected 5) (Transmit TSI of the offramp gateway) (Transmit SUB:130 extracted from left hand side of email address) (Transmit SID of the offramp gateway) Transmit DCS (with SUB/SID)-bit(s) set 6) Continue with normal facsimile procedure (transmit fax message) 9) Receive in Phase D confirmation from the called facsimile terminal. 10) Switch back to telephone.	2) Facsimile terminal detects ring and answers the call Transmit CED/Begin facsimile procedure 3) (Transmit CSI) Transmit DIS; optional SUB- and SID-bits set. 7) Continue with normal facsimile procedure (receive fax message) 8) Send Phase D confirmation to the calling offramp gateway 11) Switch back to telephone.

VIII.2 Internet routing using real-time fax

For further study.

VIII.3 Internet polling

For further study.

SERIES OF ITU-T RECOMMENDATIONS

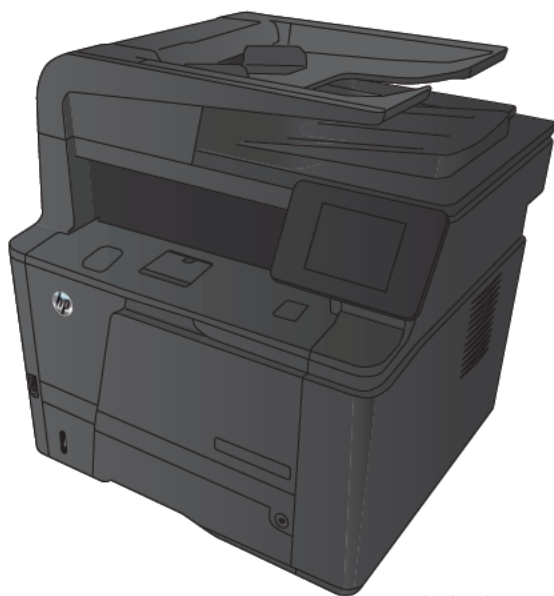
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Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	Transmission systems and media, digital systems and networks
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Cable networks and transmission of television, sound programme and other multimedia signals
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Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	Switching and signalling
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
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Series V	Data communication over the telephone network
Series X	Data networks, open system communications and security
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Series Z	Languages and general software aspects for telecommunication systems

Appendix C



LASERJET PRO 400 MFP

User Guide



M425



HP LaserJet Pro 400 MFP M425 Series

User Guide

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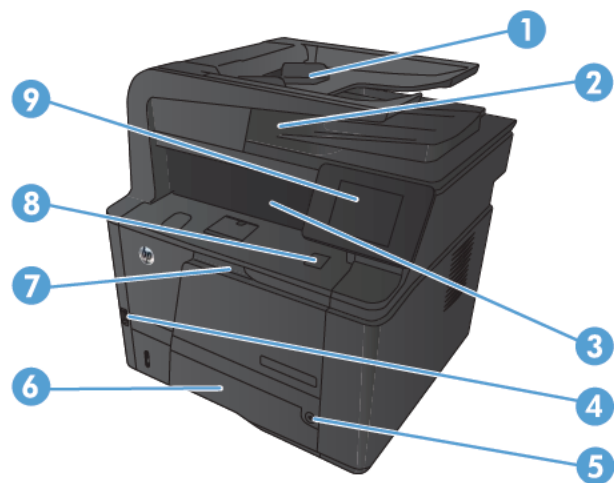
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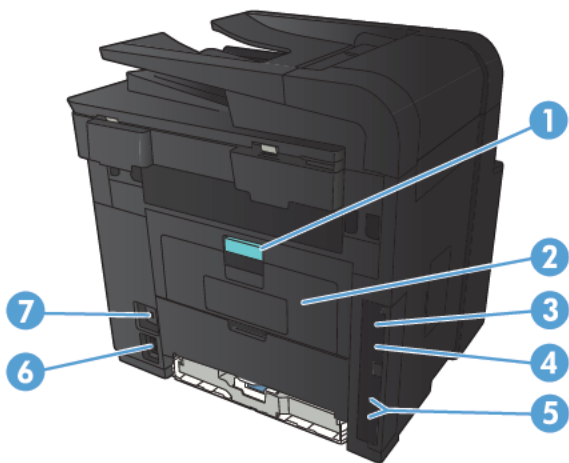
Product views

Product front view



1	Document feeder
2	Dual-head scanner
3	Output bin
4	Walk-up USB port
5	Power button
6	Tray 2
7	Tray 1
8	Front door release button
9	Color touchscreen control panel

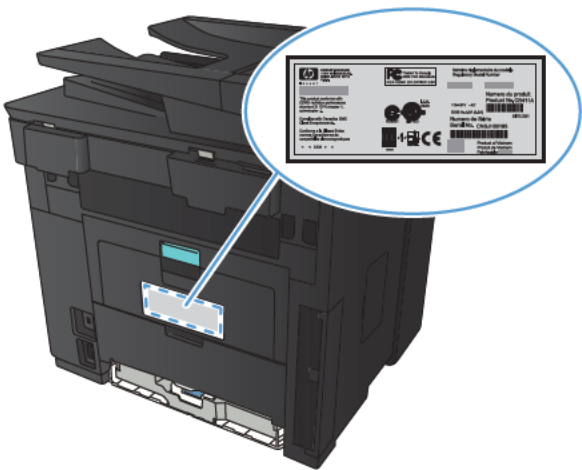
Product back view



1	Rear jam-access door latch
2	Straight-through paper path door
3	Hi-Speed USB 2.0 port
4	Network port
5	Fax and telephone ports
6	Power connection
7	Slot for a cable-type security lock

Serial number and model number location

The serial number and product model number label is on the back of the product.




Control panel layout

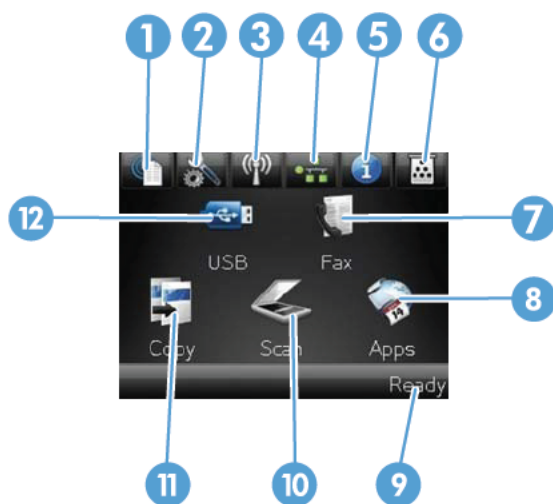








1	Touchscreen display
2	Help button and light: provides access to the control panel help system
3	Right arrow button and light: moves the cursor to the right or moves the display image to the next screen
	NOTE: This button illuminates only when the current screen can use this feature.
4	Cancel button and light: clears settings, cancels the current job or exits the current screen
	NOTE: This button illuminates only when the current screen can use this feature.
5	Wireless light: indicates the wireless network is enabled. The light blinks while the product is establishing a connection to the wireless network (HP LaserJet Pro 400 MFP M425dw only).
6	Attention light: indicates a problem with the product
7	Ready light: indicates the product is ready
8	Back button and light: returns to the previous screen
	NOTE: This button illuminates only when the current screen can use this feature.
9	Left arrow button and light: moves the cursor to the left
	NOTE: This button illuminates only when the current screen can use this feature.
10	Home button and light: provides access to the Home screen

Control-panel Home screen

The Home screen provides access to the product features, and it indicates the product status.


 **NOTE:** Depending on the product configuration, the features on the Home screen can vary. The layout might also be reversed for some languages.




1	Web Services  button: provides quick access to HP Web Services features, including HP ePrint HP ePrint is a tool that prints documents by using any email enabled device to send them to the product's email address.
2	Setup  button: provides access to the main menus
3	Wireless  button: provides access to the Wireless Menu and wireless status information (HP LaserJet Pro 400 MFP M425dw model only) NOTE: When you are connected to a wireless network, this icon changes to a set of signal strength bars.
4	Network  button: provides access to network settings and information. From the network settings screen, you can print the Network Summary page.
5	Information  button: provides product status information. From the status summary screen, you can print the Configuration Report page.
6	Supplies  button: provides information about supplies status. From the supplies summary screen, you can print the Supplies Status page.
7	Fax button: provides access to the Fax feature
8	Apps button: provides access to the Apps menu to print directly from Web applications that you have downloaded from the HP ePrintCenter Web site at www.hpeprintcenter.com
9	Product status
10	Scan button: provides access to the scan feature
11	Copy button: provides access to the copy feature
12	USB button: provides access to the USB Flash Drive menu

Print product reports

Product reports reside within the product memory. These pages help diagnose and solve problems with the product.

 **NOTE:** If the product language was not correctly set during installation, you can set the language manually so the information pages print in one of the supported languages. Change the language by using the [System Setup](#) menu on the control panel or the embedded Web server.

From the [Reports](#) menu, you can print several informative pages about the product.

1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the [Reports](#) button.
3. Touch the name of the report that you want to print.

Menu item	Description
Demo Page	Prints a page that demonstrates print quality
Menu Structure	Prints a map of the control panel-menu layout. The active settings for each menu are listed.
Configuration Report	Prints a list of all the product settings. Includes network information when the product is connected to a network.
Supplies Status	Prints the status for each toner cartridge, including the following information: <ul style="list-style-type: none">• Estimated percentage of cartridge life remaining• Approximate pages remaining• Part numbers for HP toner cartridges• Number of pages printed
Network Summary	Prints a list of all product network settings
Usage Page	Prints a page that lists PCL pages, PCL 6 pages, PS pages, pages that were jammed or mispicked in the product, monochrome (black and white) or color pages; and reports the page count
PCL Font List	Prints a list of all the PCL fonts that are installed
PS Font List	Prints a list of all the PostScript (PS) fonts that are installed
PCL6 Font List	Prints a list of all the PCL6 fonts that are installed
Service Page	Prints the service report

Printer sharing disclaimer

HP does not support peer-to-peer networking, as the feature is a function of Microsoft operating systems and not of the HP printer drivers. Go to Microsoft at www.microsoft.com.

2 Paper tray

- [Supported paper sizes](#)
- [Supported paper types](#)
- [Load the input trays](#)

Supported paper sizes

This product supports a number of paper sizes, and it adapts to various media.



NOTE: To obtain best results, select the correct paper size and type in the print driver before printing.

Table 2-1 Supported paper and print media sizes

Size and dimensions	Tray 1	Tray 2	Optional 500-sheet Tray 3	Duplexer
Letter 216 x 279 mm (8.5 x 11 in)	✓	✓	✓	✓
Legal 216 x 356 mm (8.5 x 14 in)	✓	✓	✓	✓
A4 210 x 297 mm (8.27 x 11.69 in)	✓	✓	✓	✓
A5 148 x 210 mm (5.83 x 8.27 in)	✓	✓	✓	
A6 105 x 148 mm (4.1 x 5.8 in)	✓	✓	✓	
B5 (JIS) 182 x 257 mm (7.17 x 10.12 in)	✓	✓	✓	
Executive 184 x 267 mm (7.24 x 10.51 in)	✓	✓	✓	
Postcard (JIS) 100 x 148 mm (3.9 x 5.8 in)	✓			
Double Postcard (JIS) 148 x 200 mm (5.8 x 7.9 in)	✓			
16K 184 x 260 mm (7.2 x 10.2 in)	✓			
16K 195 x 270 mm (7.7 x 10.6 in)	✓			
16K 197 x 273 mm (7.8 x 10.8 in)	✓			
8.5 x 13 216 x 330 mm (8.5 x 13 in)	✓	✓	✓	
Envelope Commercial #10 105 x 241 mm (4.13 x 9.49 in)	✓			

Table 2-1 Supported paper and print media sizes (continued)

Size and dimensions	Tray 1	Tray 2	Optional 500-sheet Tray 3	Duplexer
Envelope B5 ISO 176 x 250 mm (6.7 x 9.8 in)	✓			
Envelope C5 ISO 162 x 229 mm (6.93 x 9.84 in)	✓			
Envelope DL ISO 110 x 220 mm (4.33 x 8.66 in)	✓			
Envelope Monarch 98 x 191 mm (3.9 x 7.5 in)	✓			
Custom 76 x 127 mm to 216 x 356 mm (3.0 x 5.0 in to 8.5 x 14 in)	✓			

Supported paper types

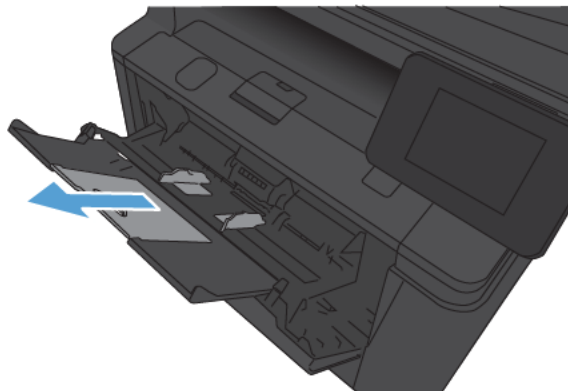
For a complete list of specific HP-brand paper that this product supports, go to www.hp.com/support/ljm425series.

Paper type (control panel)	Paper type (print driver)	Tray 1	Tray 2	Optional 500-sheet Tray 3	Duplexer
PLAIN	Plain	✓	✓	✓	✓
HP EcoSMART Lite	HP EcoSMART Lite	✓	✓	✓	✓
LIGHT 60-74 G	Light 60-74g	✓	✓	✓	✓
MID-WEIGHT 96-110 G	Mid-weight	✓	✓	✓	✓
HEAVY 111-130 G	Heavy 111-130g	✓	✓	✓	
EXTRA HEAVY 131-175 G	Extra heavy 131-175g	✓			
TRANSPARENCY	Monochrome Laser Transparency	✓	✓	✓	
LABELS	Labels	✓			
LETTERHEAD	Letterhead	✓	✓	✓	✓
PREPRINTED	Preprinted	✓	✓	✓	✓
PREPUNCHED	Prepunched	✓	✓	✓	✓
COLOR	Colored	✓	✓	✓	✓
ROUGH	Rough	✓	✓	✓	
BOND	Bond	✓	✓	✓	✓
RECYCLED	Recycled	✓	✓	✓	✓
ENVELOPE	Envelope	✓			

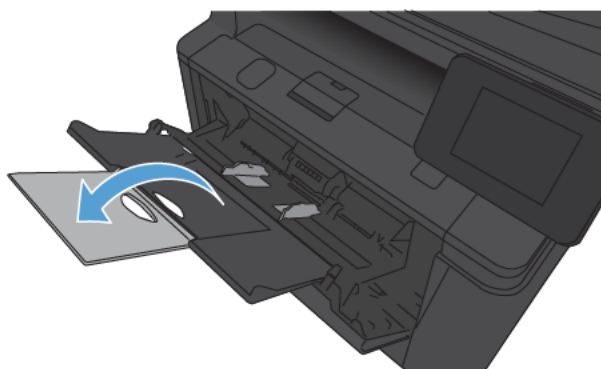
Load the input trays

Load Tray 1

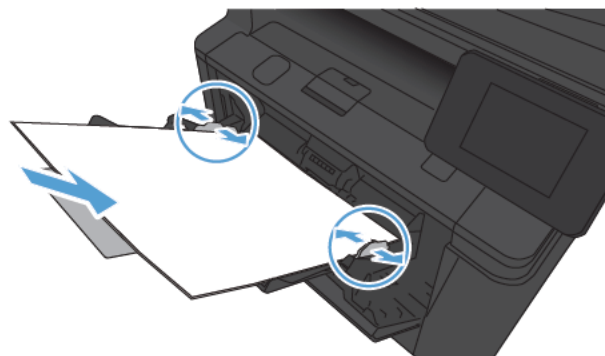
1. Open Tray 1, and pull the tray extension away from the product.



2. For long paper, flip out the extension to help hold the paper in the tray.



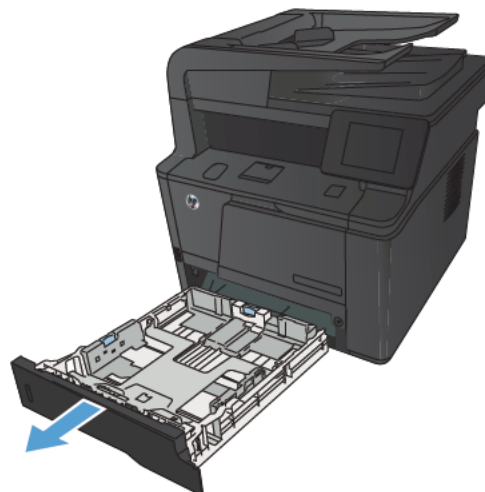
3. Place the paper stack into Tray 1, and slide the paper guides so that they are against the sheets.



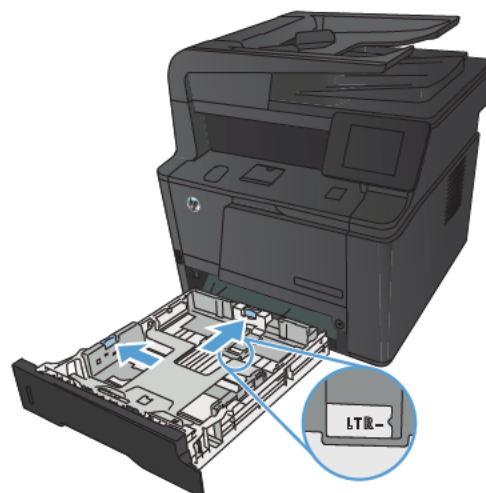
4. Feed the paper stack into the tray as far as it will go.

Load Tray 2

1. Pull the tray out of the product.

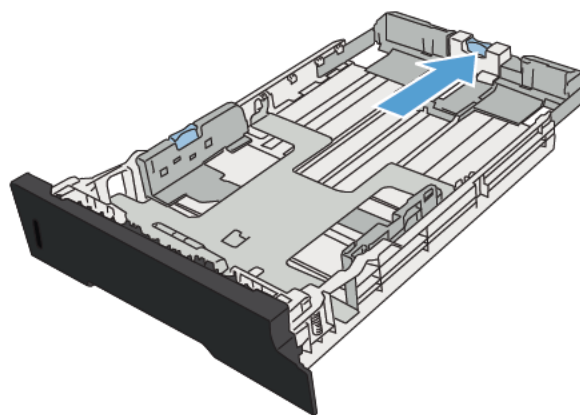


2. Slide open the paper length and width guides by pushing outward on the blue tabs.

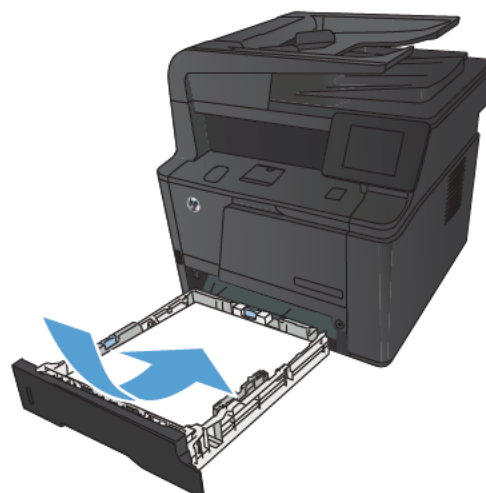


3. To load Legal-size paper, extend the tray by pressing the release button at the back of the tray inward and pulling the back of the tray out.

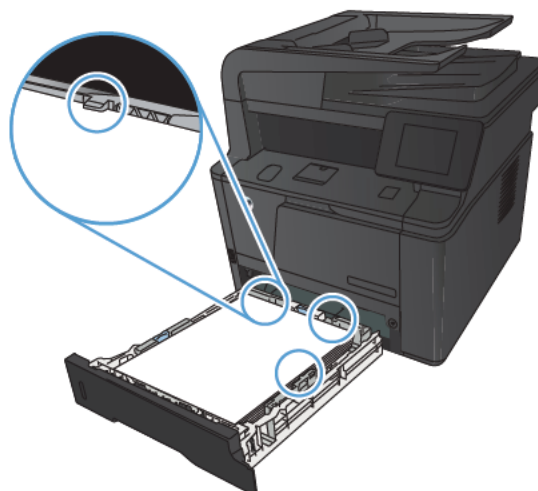
NOTE: When loaded with Legal-size paper, the tray extends from the rear of the product approximately 70 mm (2.75 in).



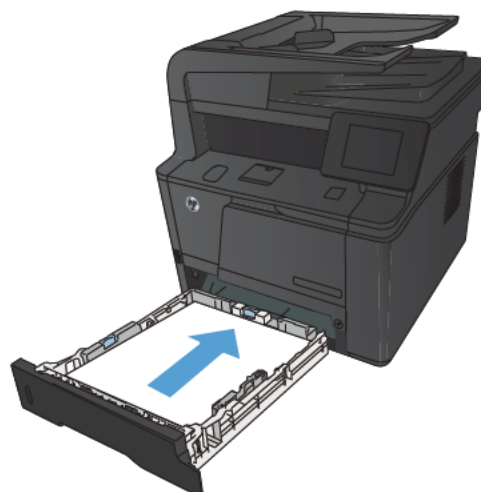
4. Place the paper in the tray and make sure that it is flat at all four corners. Slide the paper length and width guides so that they are against the stack of paper.



5. Push down on the paper to make sure that the paper stack is below the paper limit tabs on the right side and rear of the tray.

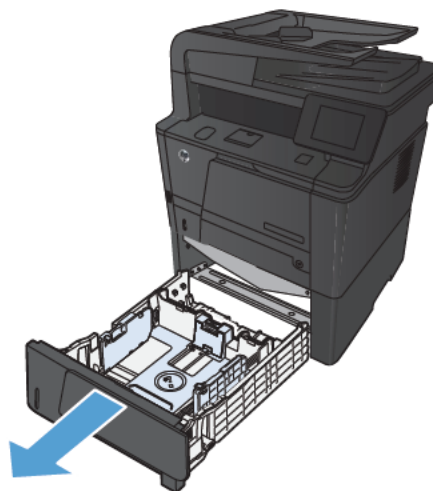


6. Slide the tray into the product.

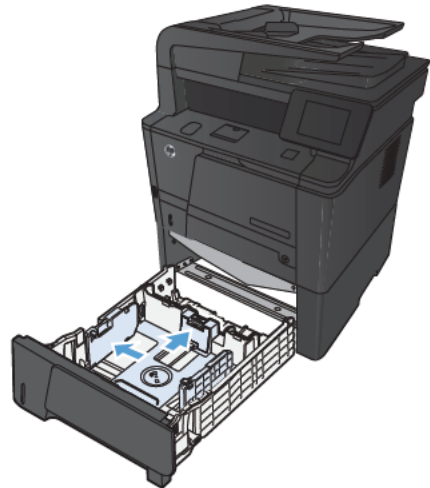


Load optional Tray 3

1. Pull the tray out of the product.

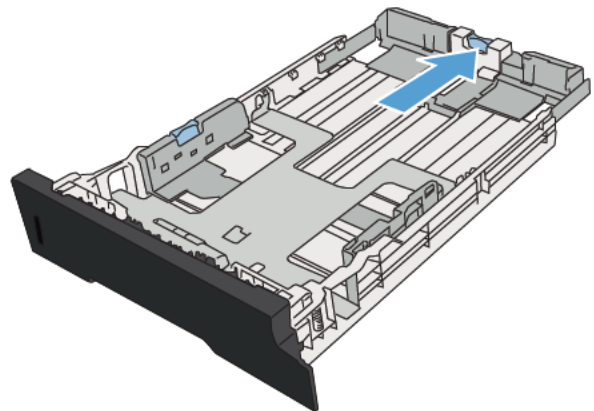


2. Slide open the paper length and width guides by pushing outward on the blue tabs.

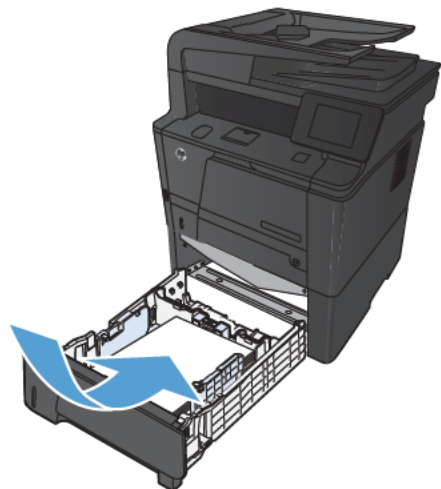


3. To load Legal-size paper, extend the tray by pressing the release button at the back of the tray inward and pulling the back of the tray out.

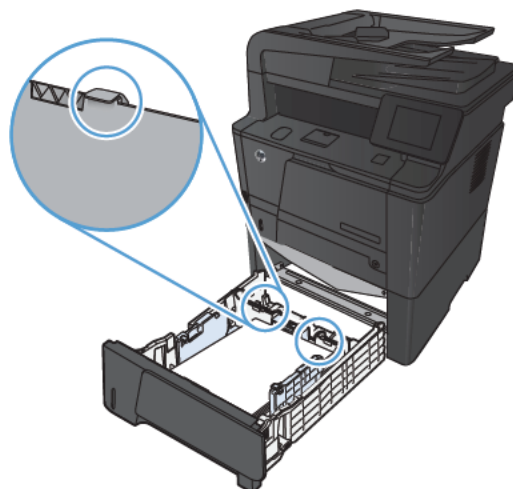
NOTE: When loaded with Legal-size paper, the tray extends from the rear of the product approximately 70 mm (2.75 in).



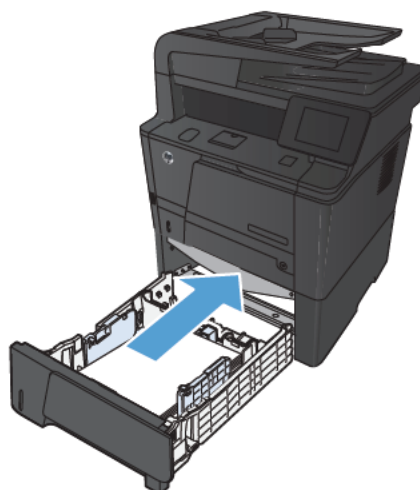
4. Place the paper in the tray and make sure that it is flat at all four corners. Slide the paper length and width guides so that they are against the stack of paper.



5. Push down on the paper to make sure that the paper stack is below the paper limit tabs at the rear of the tray.



6. Slide the tray into the product.



3 Print

- [Supported printer drivers \(Windows\)](#)
- [Change print-job settings \(Windows\)](#)
- [Change print-job settings \(Mac OS X\)](#)
- [Print tasks for Windows](#)
- [Print tasks for Mac OS X](#)
- [Additional print tasks \(Windows\)](#)
- [Additional print tasks \(Mac OS X\)](#)
- [Create archival-quality prints](#)
- [Use HP ePrint](#)
- [Use AirPrint](#)
- [Walk-up USB printing](#)

Supported printer drivers (Windows)

Printer drivers provide access to the product features and allow the computer to communicate with the product (using a printer language). Check the installation notes and readme files on the product CD for additional software and languages.

HP PCL 6 driver description

- Installs automatically when installing the product software
- Provided as the default driver
- Recommended for printing in all supported Windows environments
- Provides the overall best speed, print quality, and product-feature support for most users
- Developed to align with the Windows Graphic Device Interface (GDI) for the best speed in Windows environments
- Might not be fully compatible with third-party and custom software programs that are based on PCL 5

HP UPD PS driver description

- Available for download from the Web at www.hp.com/support/ljm425series
- Recommended for printing with Adobe® software programs or with other highly graphics-intensive software programs
- Provides support for printing from postscript emulation needs, or for postscript flash font support

HP UPD PCL 5 driver description

- Available for download from the Web at www.hp.com/support/ljm425series
- Compatible with previous PCL versions and older HP LaserJet products
- The best choice for printing from third-party or custom software programs
- Designed for use in corporate Windows environments to provide a single driver for use with multiple printer models
- Preferred when printing to multiple printer models from a mobile Windows computer

HP UPD PCL 6 driver description

- Available for download from the Web at www.hp.com/support/ljm425series
- Recommended for printing in all supported Windows environments
- Provides the overall best speed, print quality, and product-feature support for most users
- Developed to align with the Windows Graphic Device Interface (GDI) for the best speed in Windows environments
- Might not be fully compatible with third-party and custom software programs that are based on PCL 5

Change print-job settings (Windows)

Priority for changing print-job settings

Changes to print settings are prioritized depending on where the changes are made:



NOTE: The names of commands and dialog boxes might vary depending on your software program.

- **Page Setup dialog box:** Click **Page Setup** or a similar command on the **File** menu of the program you are working in to open this dialog box. Settings changed here override settings changed anywhere else.
- **Print dialog box:** Click **Print**, **Print Setup**, or a similar command on the **File** menu of the program you are working in to open this dialog box. Settings changed in the **Print** dialog box have a lower priority and usually do not override changes made in the **Page Setup** dialog box.
- **Printer Properties dialog box (printer driver):** Click **Properties** in the **Print** dialog box to open the printer driver. Settings changed in the **Printer Properties** dialog box usually do not override settings anywhere else in the printing software. You can change most of the print settings here.
- **Default printer driver settings:** The default printer driver settings determine the settings used in all print jobs, *unless* settings are changed in the **Page Setup**, **Print**, or **Printer Properties** dialog boxes.
- **Printer control panel settings:** Settings changed at the printer control panel have a lower priority than changes made anywhere else.

Change the settings for all print jobs until the software program is closed

1. From the software program, select the **Print** option.
2. Select the driver, and then click **Properties** or **Preferences**.

Change the default settings for all print jobs

1. **Windows XP, Windows Server 2003, and Windows Server 2008 (using the default Start menu view):** Click **Start**, and then click **Printers and Faxes**.

Windows XP, Windows Server 2003, and Windows Server 2008 (using the Classic Start menu view): Click **Start**, click **Settings**, and then click **Printers**.

Windows Vista: Click **Start**, click **Control Panel**, and then in the category for **Hardware and Sound** click **Printer**.

Windows 7: Click **Start**, and then click **Devices and Printers**.

2. Right-click the driver icon, and then select **Printing Preferences**.

Change the product configuration settings

1. **Windows XP, Windows Server 2003, and Windows Server 2008 (using the default Start menu view):** Click **Start**, and then click **Printers and Faxes**.

Windows XP, Windows Server 2003, and Windows Server 2008 (using the Classic Start menu view): Click **Start**, click **Settings**, and then click **Printers**.

Windows Vista: Click **Start**, click **Control Panel**, and then in the category for **Hardware and Sound** click **Printer**.

Windows 7: Click **Start**, and then click **Devices and Printers**.

2. Right-click the driver icon, and then select **Properties** or **Printer properties**.
3. Click the **Device Settings** tab.

Change print-job settings (Mac OS X)

Priority for changing print-job settings

Changes to print settings are prioritized depending on where the changes are made:



NOTE: The names of commands and dialog boxes might vary depending on your software program.

- **Page Setup dialog box:** Click **Page Setup** or a similar command on the **File** menu of the program you are working in to open this dialog box. Settings changed here might override settings changed anywhere else.
- **Print dialog box:** Click **Print**, **Print Setup**, or a similar command on the **File** menu of the program you are working in to open this dialog box. Settings changed in the **Print** dialog box have a lower priority and do *not* override changes made in the **Page Setup** dialog box.
- **Default print driver settings:** The default print driver settings determine the settings used in all print jobs, *unless* settings are changed in the **Page Setup** or **Print** dialog boxes.
- **Printer control panel settings:** Settings changed at the printer control panel have a lower priority than changes made anywhere else.

Change the settings for all print jobs until the software program is closed


1. On the **File** menu, click the **Print** item.
2. In the **Printer** menu, select this product.
3. From the settings drop-down list, change the settings that you want to change.

Change the default settings for all print jobs

1. On the **File** menu, click the **Print** item.
2. In the **Printer** menu, select this product.
3. From the settings drop-down list, change the settings that you want to change.
4. On the **Presets** menu, click the **Save As...** option and type a name for the preset.

These settings are saved in the **Presets** menu. To use the new settings, you must select the saved preset option every time you open a program and print.

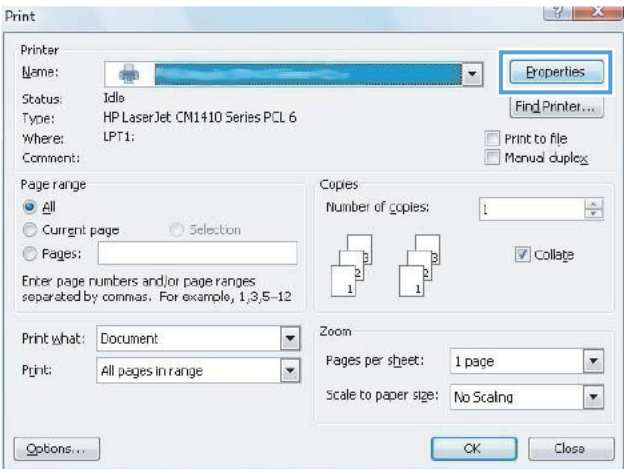
Change the product configuration settings

1. From the Apple menu , click the **System Preferences** menu and then click the **Print & Fax** icon.
2. Select the product in the left side of the window.
3. Click the **Options & Supplies** button.
4. Click the **Driver** tab.
5. Configure the installed options.

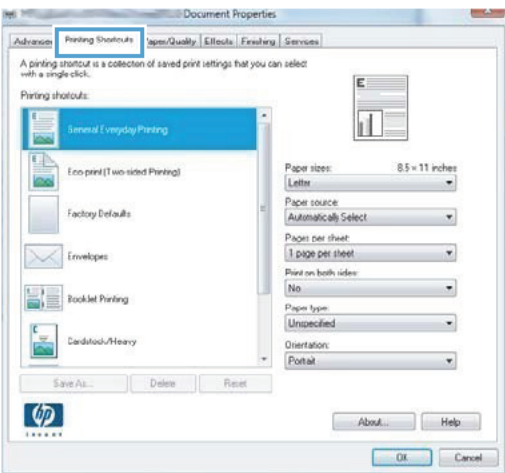
Print tasks for Windows

Use a printing shortcut (Windows)

- 1. From the software program, select the **Print** option.
- 2. Select the product, and then click the **Properties** or **Preferences** button.

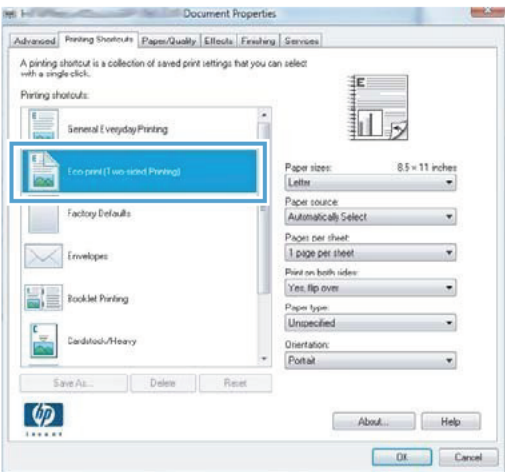


- 3. Click the **Printing Shortcuts** tab.



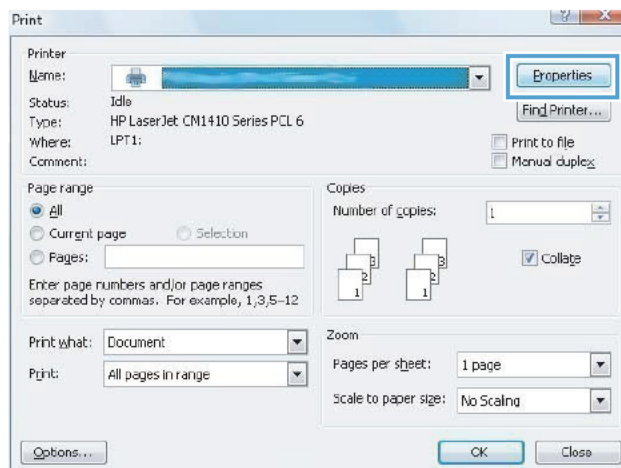
- 4. Select one of the shortcuts, and then click the **OK** button.

NOTE: When you select a shortcut, the corresponding settings change on the other tabs in the printer driver.

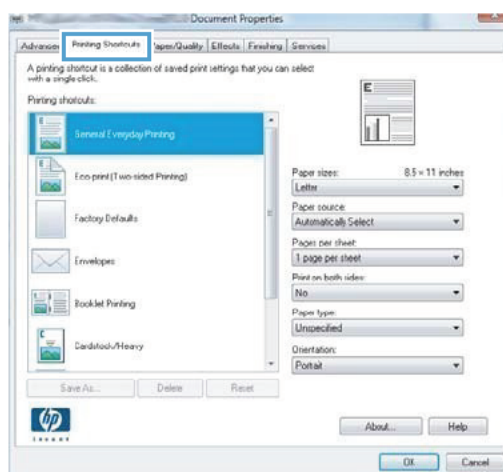


Create a printing shortcut (Windows)

1. From the software program, select the **Print** option.
2. Select the product, and then click the **Properties** or **Preferences** button.

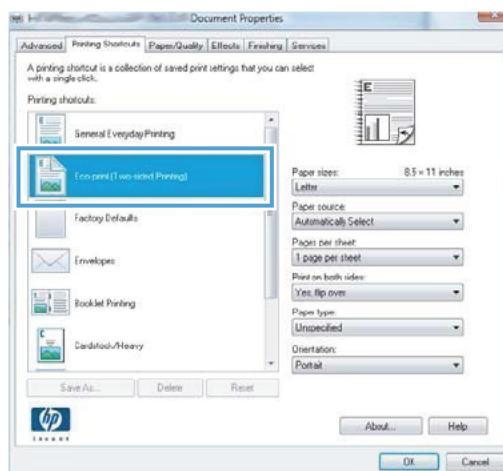


3. Click the **Printing Shortcuts** tab.



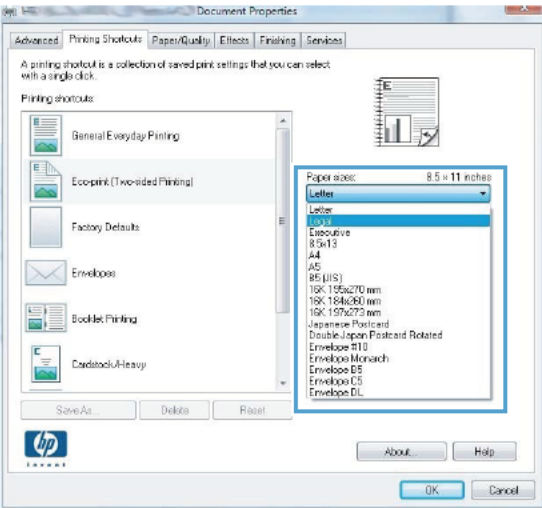
4. Select an existing shortcut as a base.

NOTE: Always select a shortcut before adjusting any of the settings on the right side of the screen. If you adjust the settings and then select a shortcut, or if you select a different shortcut, all your adjustments are lost.

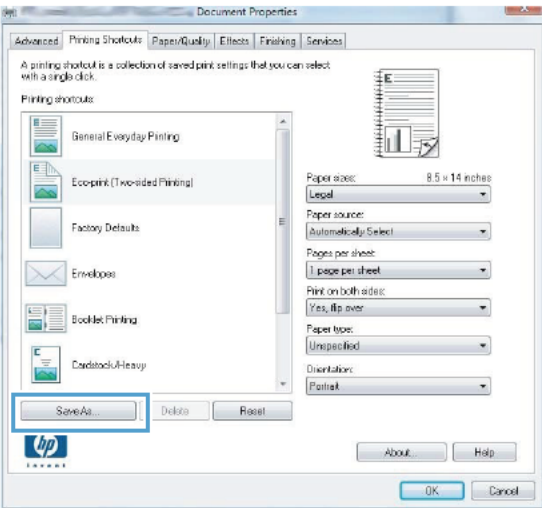


5. Select the print options for the new shortcut.

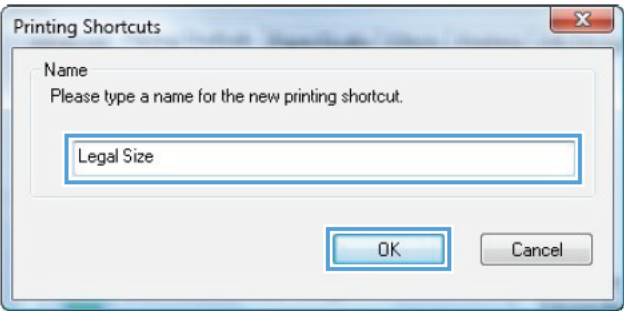
NOTE: You can select the print options on this tab or on any other tab in the printer driver. After selecting options on other tabs, return to the **Printing Shortcuts** tab before continuing with the next step.



6. Click the **Save As** button.

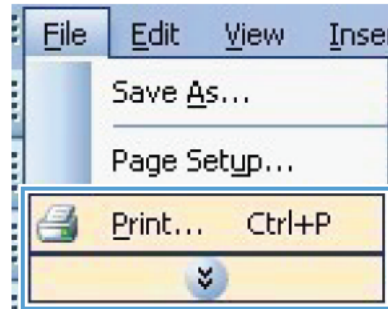


7. Type a name for the shortcut, and click the **OK** button.

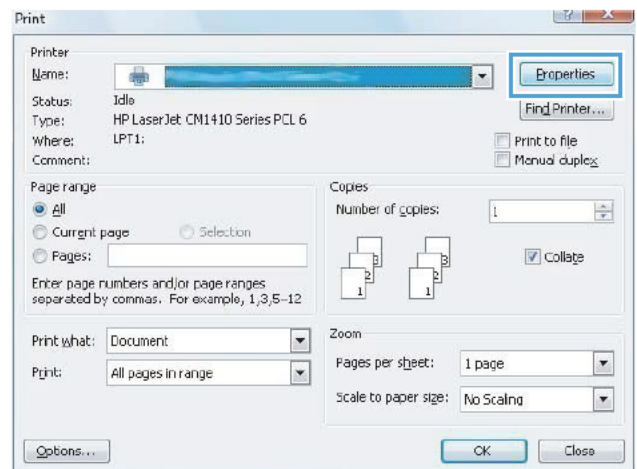


Automatically print on both sides with Windows

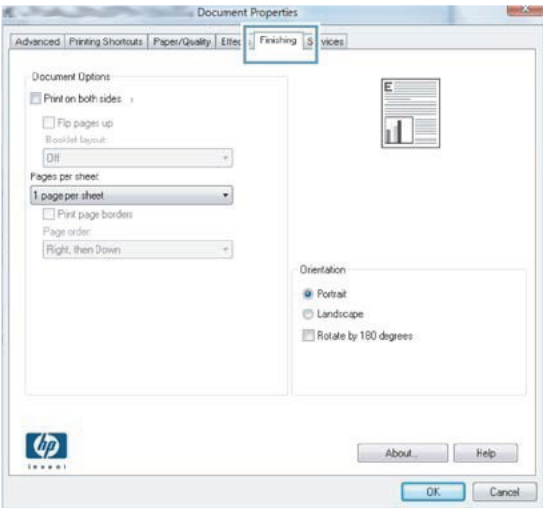
1. On the **File** menu in the software program, click **Print**.



2. Select the product, and then click the **Properties** or **Preferences** button.

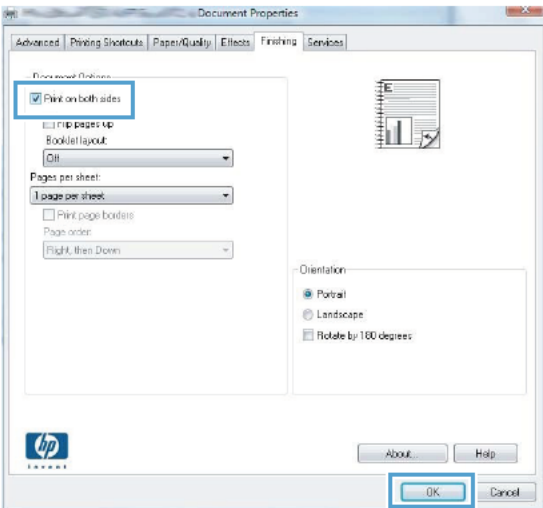


3. Click the **Finishing** tab.




4. Select the **Print on both sides** check box. Click the **OK** button to print the job.

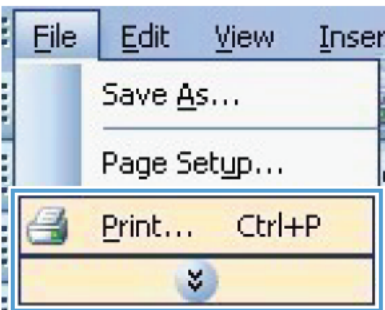
NOTE: If the product is a duplex model and only manual duplex appears, either the duplex unit is not installed correctly in the **Device Settings** tab of the **Printer Properties** dialog box, or the media type is not supported by the duplex unit.



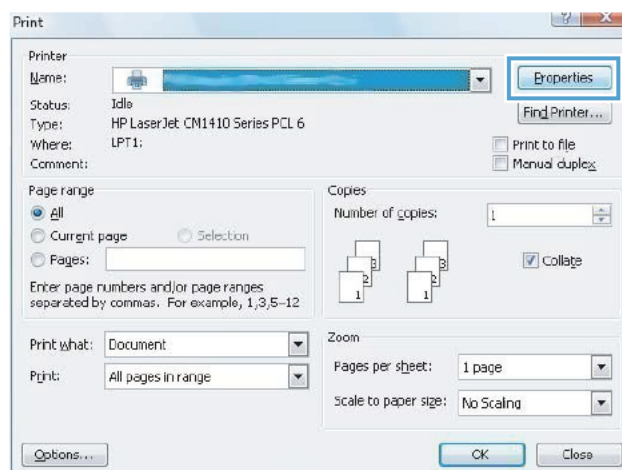
Manually print on both sides with Windows

 **NOTE:** This product includes an automatic two-sided printing feature. However, the product also can print two-sided jobs manually if the paper is not supported by automatic two-sided printing, or if the duplex unit has been disabled.

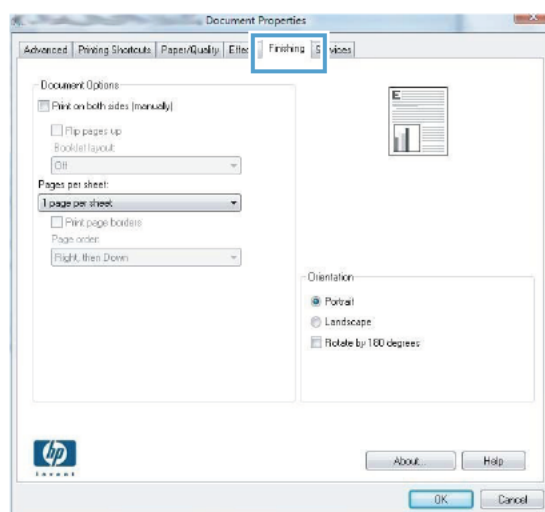
1. On the **File** menu in the software program, click **Print**.



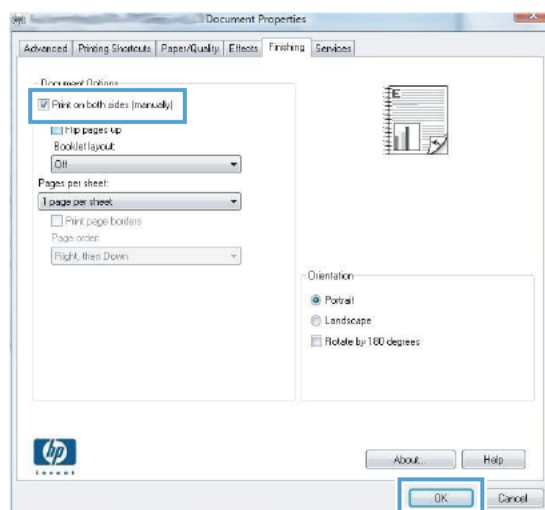
2. Select the product, and then click the **Properties** or **Preferences** button.



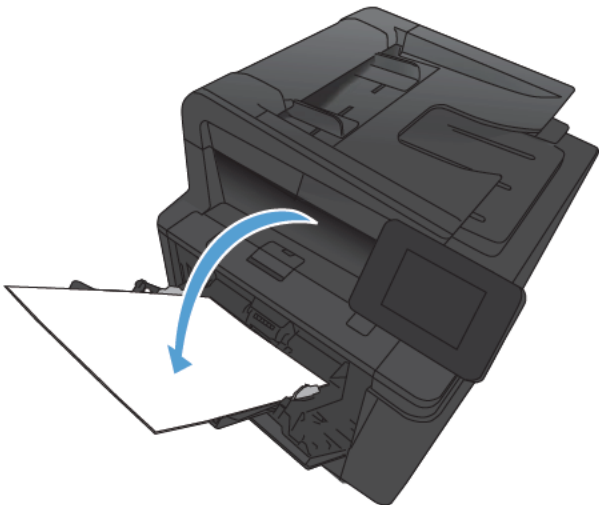
3. Click the **Finishing** tab.



4. Select the **Print on both sides (manually)** check box. Click the **OK** button to print the first side of the job.



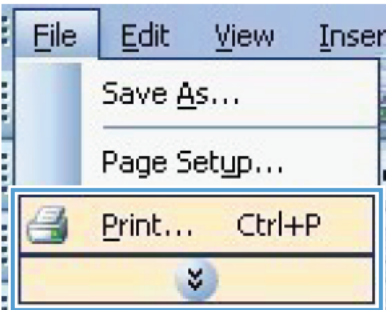
- 5. Retrieve the printed stack from the output bin and, maintaining the same orientation, place it in Tray 1 with the printed side down and the top of the pages toward the product.



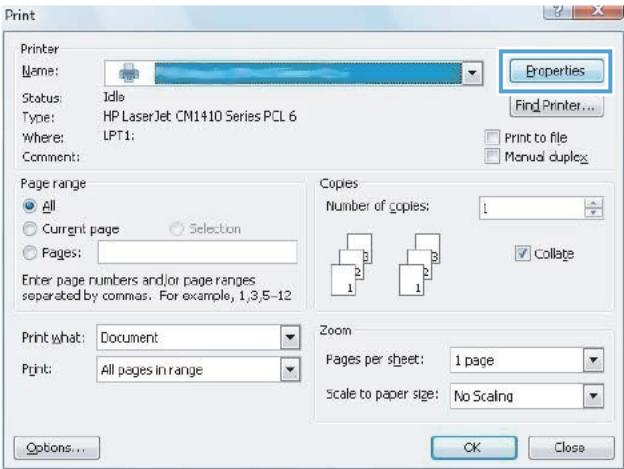
- 6. On the control panel, press the **OK** button to print the second side of the job.

Print multiple pages per sheet with Windows

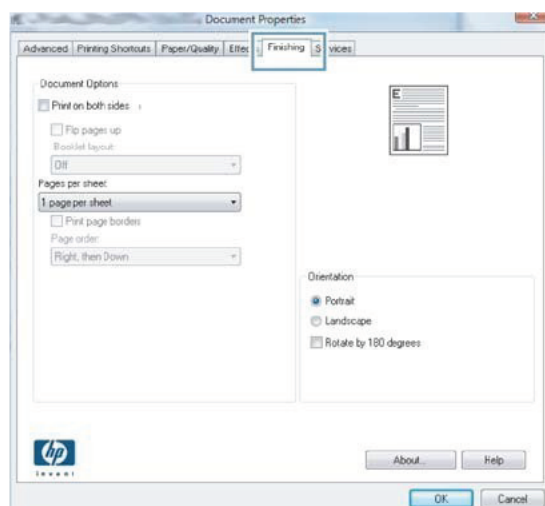
- 1. On the **File** menu in the software program, click **Print**.



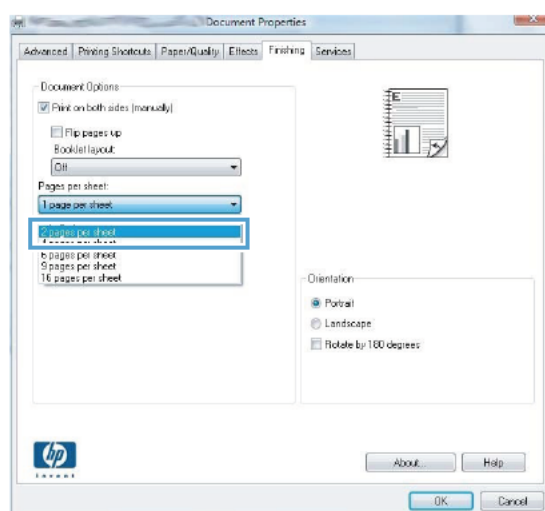
- 2. Select the product, and then click the **Properties** or **Preferences** button.



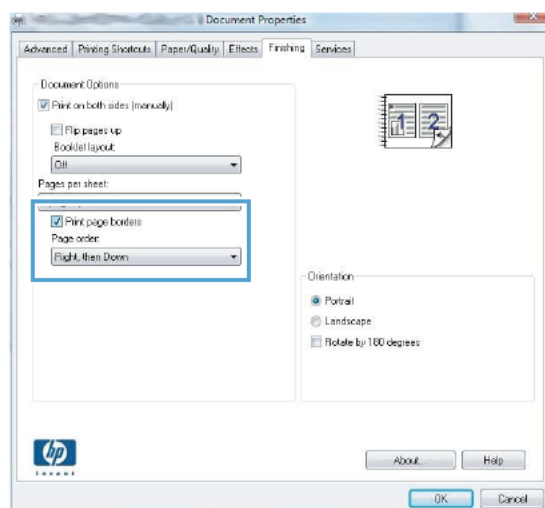
3. Click the **Finishing** tab.



4. Select the number of pages per sheet from the **Pages per sheet** drop-down list.

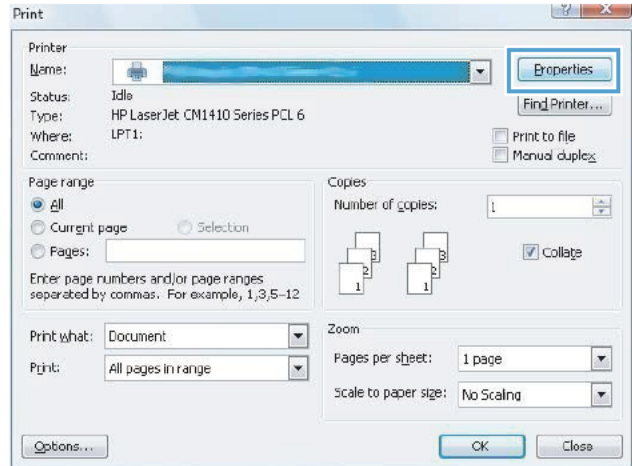


5. Select the correct **Print page borders**, **Page order**, and **Orientation** options.

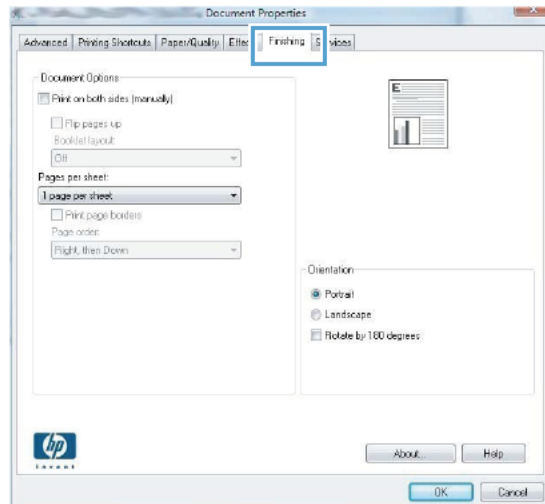


Select the page orientation (Windows)

1. From the software program, select the **Print** option.
2. Select the product, and then click the **Properties** or **Preferences** button.

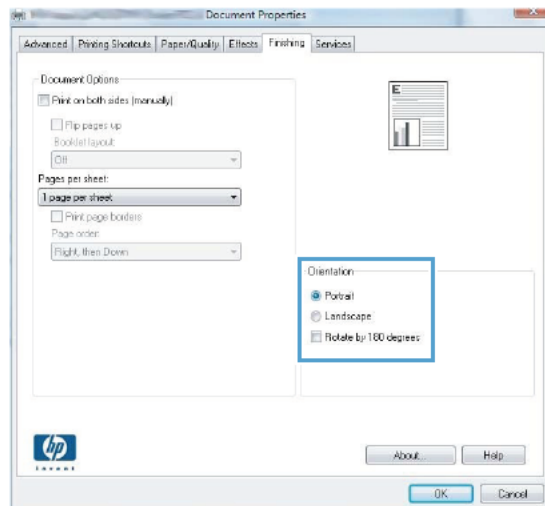


3. Click the **Finishing** tab.



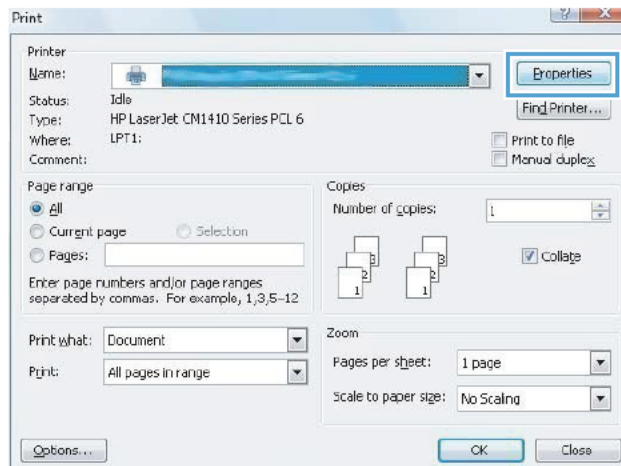
4. In the **Orientation** area, select the **Portrait** or **Landscape** option.

To print the page image upside down, select the **Rotate by 180 degrees** option.

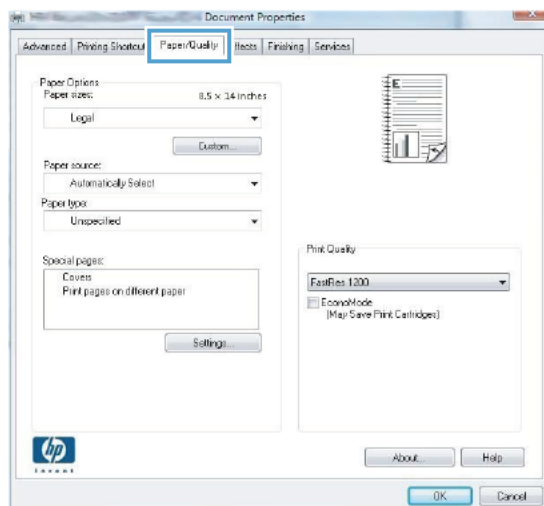


Select the paper type (Windows)

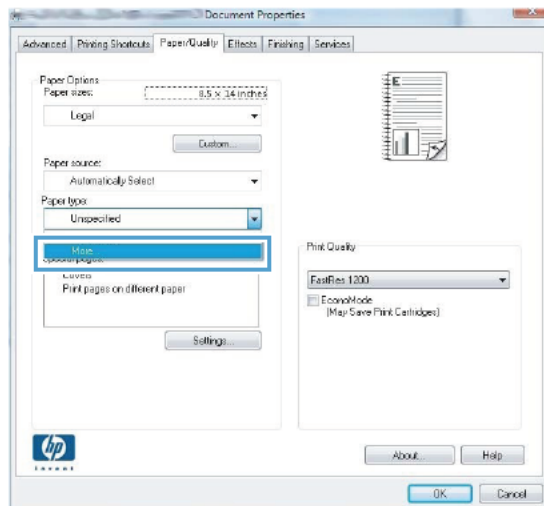
1. From the software program, select the **Print** option.
2. Select the product, and then click the **Properties** or **Preferences** button.



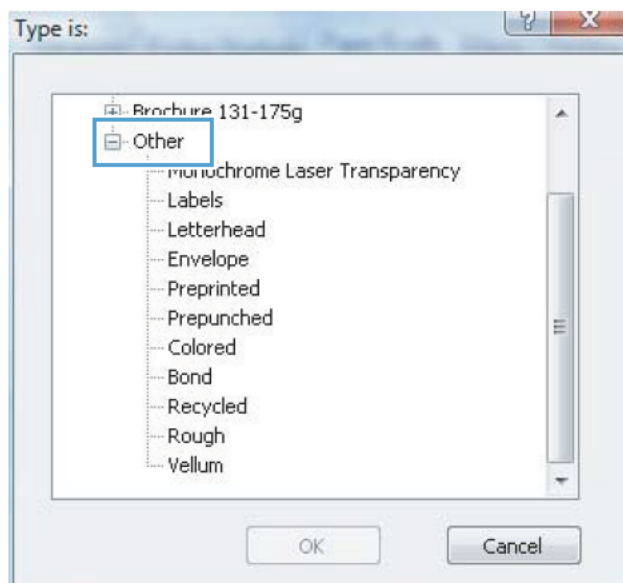
3. Click the **Paper/Quality** tab.



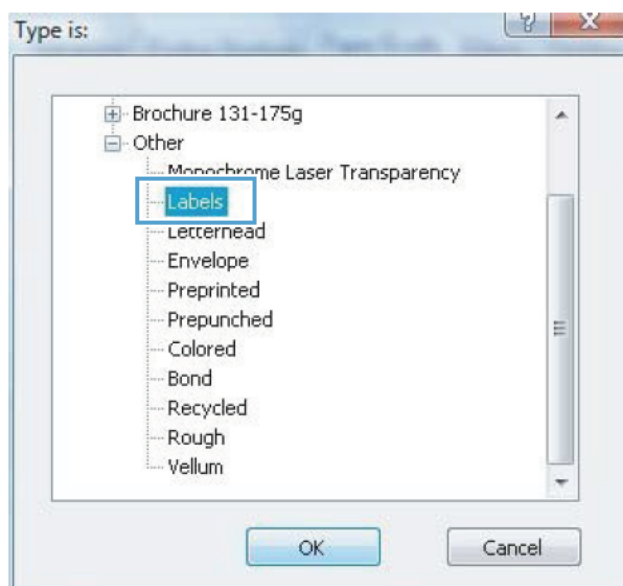
4. From the **Paper type** drop-down list, click the **More...** option.



5. Select the category of paper types that best describes your paper.



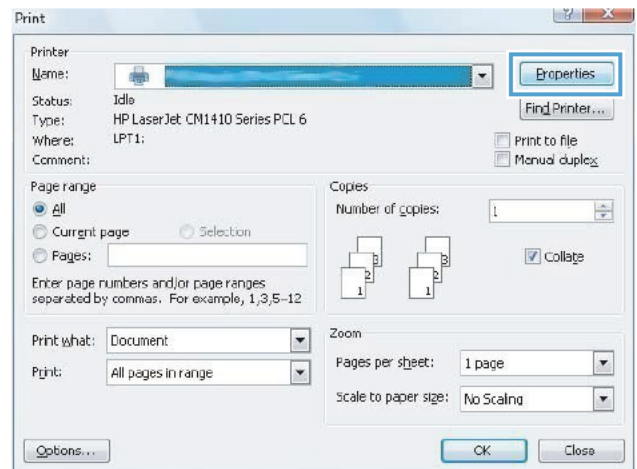
6. Select the option for the type of paper you are using, and click the **OK** button.



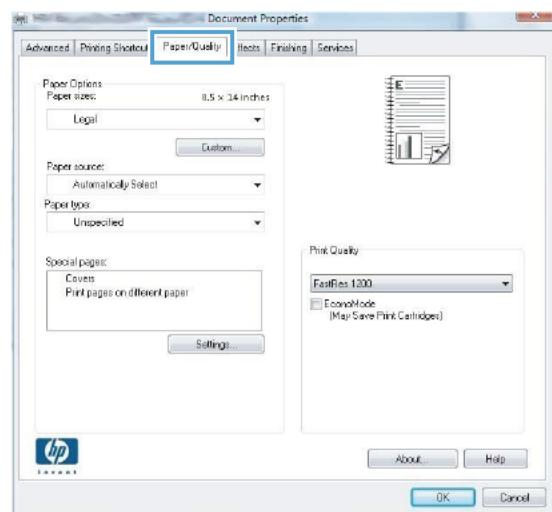
Print the first or last page on different paper (Windows)

1. From the software program, select the **Print** option.

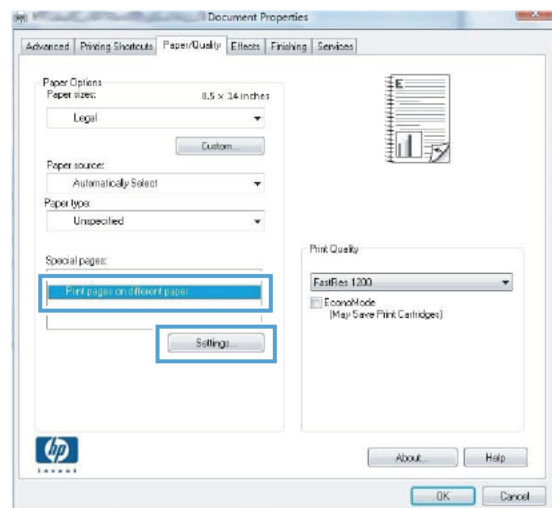
2. Select the product, and then click the **Properties** or **Preferences** button.



3. Click the **Paper/Quality** tab.



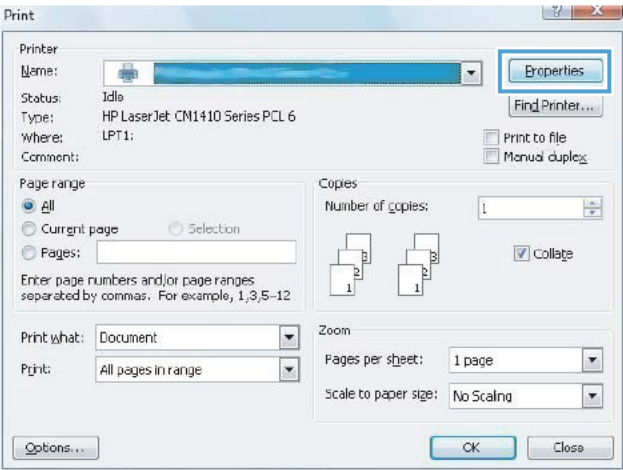
4. Click the **Print pages on different paper** item, and then click the **Settings** button to select the necessary settings for the front cover, other pages, and back cover.



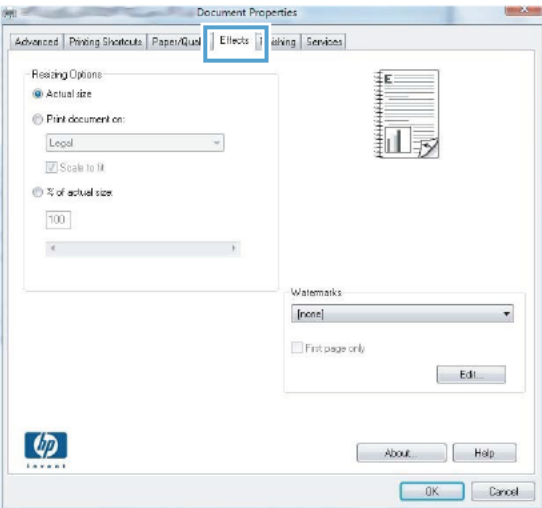
Scale a document to fit page size (Windows)

1. From the software program, select the **Print** option.

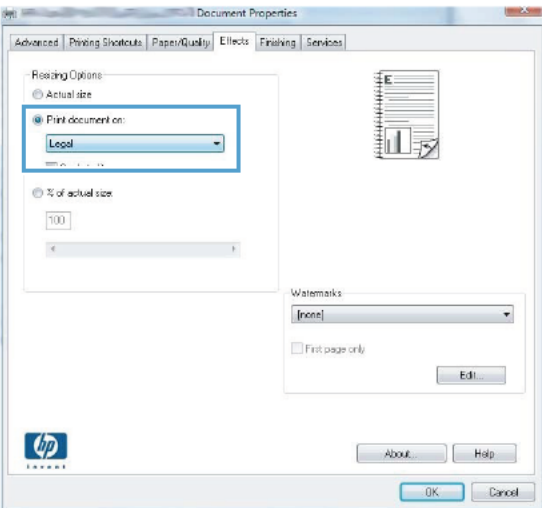
- 2. Select the product, and then click the **Properties** or **Preferences** button.



- 3. Click the **Effects** tab.



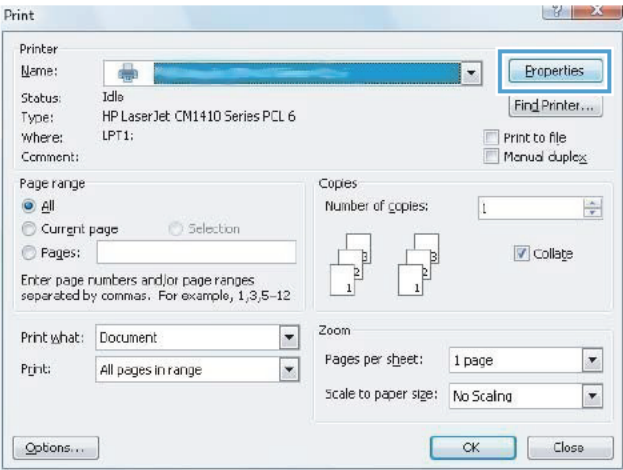
- 4. Select the **Print document on** option, and then select a size from the drop-down list.



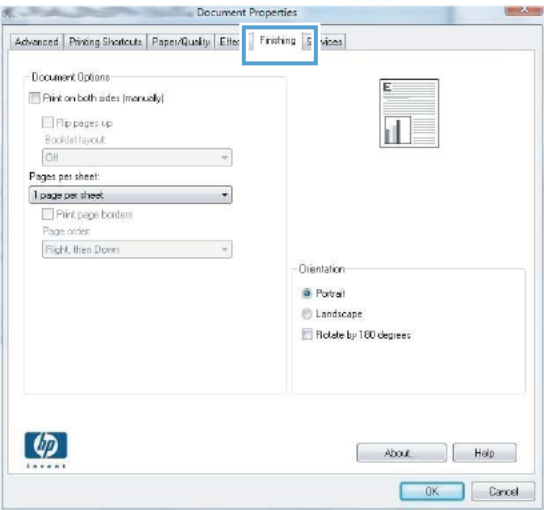
Create a booklet (Windows)

- 1. From the software program, select the **Print** option.

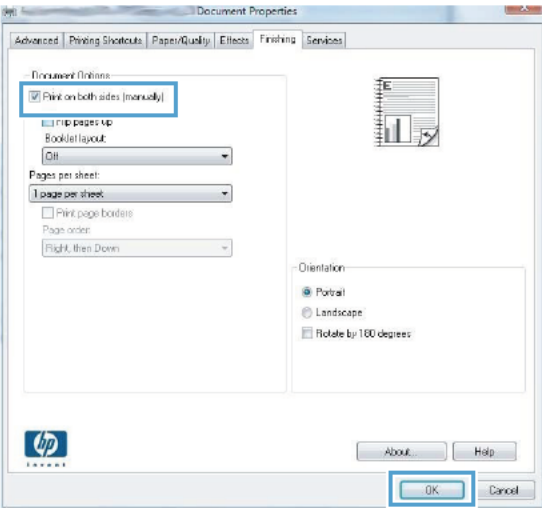
2. Select the product, and then click the **Properties** or **Preferences** button.



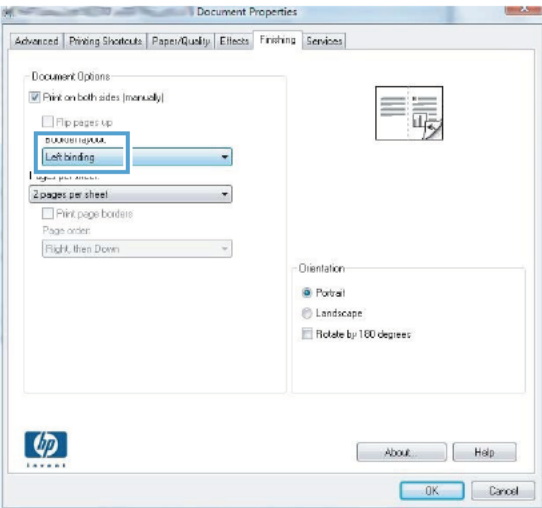
3. Click the **Finishing** tab.



4. Click the **Print on both sides** or **Print on both sides (manually)** check box.



5. In the **Booklet layout** drop-down list, select a binding option. The **Pages per sheet** option automatically changes to **2 pages per sheet**.



Print tasks for Mac OS X

Use a printing preset (Mac OS X)

1. On the **File** menu, click the **Print** option.
2. In the **Printer** menu, select this product.
3. In the **Presets** menu, select the printing preset.
4. Click the **Print** button.



NOTE: To use printer-driver default settings, select the **standard** option.

Create a printing preset (Mac OS X)

Use printing presets to save the current printer driver settings for reuse.

1. On the **File** menu, click the **Print** option.
2. In the **Printer** menu, select this product.
3. Select the print settings that you want to save for reuse.
4. In the **Presets** menu, click the **Save As...** option, and type a name for the preset.
5. Click the **OK** button.

Automatically print on both sides (Mac OS X)

1. Insert enough paper into one of the trays to accommodate the print job.
2. On the **File** menu, click the **Print** option.
3. In the **Printer** drop-down list, select this product.
4. Select the **Layout** drop-down item.
5. From the **Two-Sided** drop-down list, select a binding option.
6. Click the **Print** button.

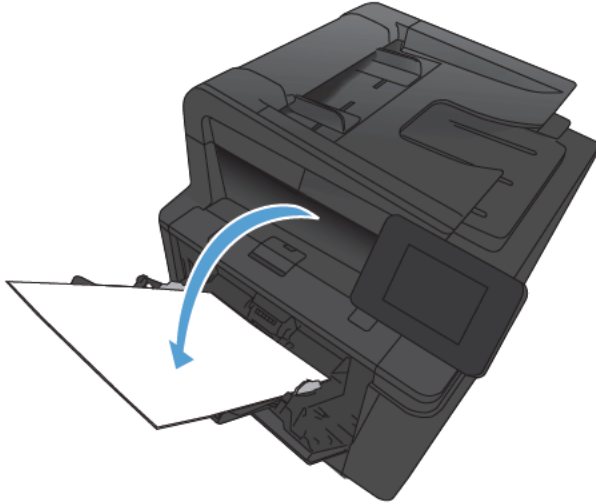
Manually print on both sides (Mac OS X)



NOTE: This product includes an automatic two-sided printing feature. However, the product also can print two-sided jobs manually if the paper is not supported by automatic two-sided printing, or if the duplex unit has been disabled.

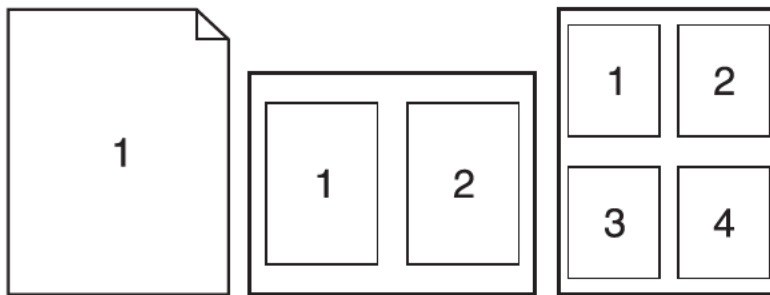
1. Insert enough paper into Tray 1 to accommodate the print job.
2. On the **File** menu, click the **Print** option.
3. In the **Printer** drop-down list, select this product.
4. Select the **Manual Duplex** drop-down item.
5. Click the **Manual Duplex** check box, and then select a binding option.

6. Click the **Print** button. Follow the instructions in the pop-up window that appears on the computer screen before replacing the output stack in Tray 1 for printing the second half.
7. Go to the product, and remove any blank paper that is in Tray 1.
8. Insert the printed stack in Tray 1 with the printed side down and the top of the pages toward the product.



9. If prompted, touch the appropriate control panel button to continue.

Print multiple pages on one sheet of paper (Mac OS X)



1. On the **File** menu, click the **Print** option.
2. In the **Printer** menu, select this product.
3. Open the **Layout** menu.
4. From the **Pages per Sheet** menu, select the number of pages that you want to print on each sheet (1, 2, 4, 6, 9, or 16).
5. In the **Layout Direction** area, select the order and placement of the pages on the sheet.

6. From the **Borders** menu, select the type of border to print around each page on the sheet.
7. Click the **Print** button.

Select the page orientation (Mac OS X)

1. On the **File** menu, click the **Print** option.
2. In the **Printer** menu, select this product.
3. In the **Copies & Pages** menu, click the **Page Setup** button.
4. Click the icon that represents the page orientation that you want to use, and then click the **OK** button.
5. Click the **Print** button.

Select the paper type (Mac OS X)

1. On the **File** menu, click the **Print** option.
2. In the **Printer** menu, select this product.
3. Open the **Finishing** menu.
4. Select a type from the **Media-type** drop-down list.
5. Click the **Print** button.

Print a cover page (Mac OS X)

1. On the **File** menu, click the **Print** option.
2. In the **Printer** menu, select this product.
3. Open the **Cover Page** menu, and then select where to print the cover page. Click either the **Before Document** button or the **After Document** button.
4. In the **Cover Page Type** menu, select the message that you want to print on the cover page.



NOTE: To print a blank cover page, select the **standard** option from the **Cover Page Type** menu.

5. Click the **Print** button.

Scale a document to fit page size (Mac OS X)





1. On the **File** menu, click the **Print** option.
2. In the **Printer** menu, select this product.
3. Open the **Paper Handling** menu.
4. In the **Destination Paper Size** area, click the **Scale to fit paper size** box, and then select the size from the drop-down list.
5. Click the **Print** button.

Create a booklet (Mac OS X)

1. On the **File** menu, click the **Print** option.
2. In the **Printer** menu, select this product.
3. Open the **Manual Duplex** menu.
4. Click the **Manual Duplex** box.
5. Open the **Booklet Printing** menu.
6. Click the **Format Output as Booklet** box, and select a binding option.
7. Select the paper size.
8. Click the **Print** button.

Additional print tasks (Windows)

Cancel a print job (Windows)

1. If the print job is currently printing, cancel it by pressing the Cancel  button on the product control panel.
-
-  **NOTE:** Pressing the Cancel  button clears the job that the product is currently processing. If more than one process is running, pressing the Cancel  button clears the process that currently appears on the product control panel.
-
2. You can also cancel a print job from a software program or a print queue.
 - **Software program:** Typically, a dialog box appears briefly on the computer screen, allowing you to cancel the print job.
 - **Windows print queue:** If a print job is waiting in a print queue (computer memory) or print spooler, delete the job there.
 - **Windows XP, Server 2003, or Server 2008:** Click **Start**, click **Settings**, and then click **Printers and Faxes**. Double-click the product icon to open the window, right-click the print job that you want to cancel, and then click **Cancel**.
 - **Windows Vista:** Click **Start**, click **Control Panel**, and then, under **Hardware and Sound**, click **Printer**. Double-click the product icon to open the window, right-click the print job that you want to cancel, and then click **Cancel**.
 - **Windows 7:** Click **Start**, and then click **Devices and Printers**. Double-click the product icon to open the window, right-click the print job that you want to cancel, and then click **Cancel**.

Select the paper size (Windows)

1. From the software program, select the **Print** option.
2. Select the product, and then click the **Properties** or **Preferences** button.
3. Click the **Paper/Quality** tab.
4. Select a size from the **Paper size** drop-down list.

Select a custom paper size (Windows)

1. From the software program, select the **Print** option.
2. Select the product, and then click the **Properties** or **Preferences** button.
3. Click the **Paper/Quality** tab.
4. Click the **Custom** button.
5. Type a name for the custom size and specify the dimensions.
 - The width is the short edge of the paper.
 - The length is the long edge of the paper.



NOTE: Always load paper into the trays short edge first.

6. Click the **Save** button, and then click the **Close** button.

Print watermarks (Windows)





1. From the software program, select the **Print** option.
2. Select the product, and then click the **Properties** or **Preferences** button.
3. Click the **Effects** tab.
4. Select a watermark from the **Watermarks** drop-down list.

Or, to add a new watermark to the list, click the **Edit** button. Specify the settings for the watermark, and then click the **OK** button.

5. To print the watermark on the first page only, select the **First page only** check box. Otherwise, the watermark is printed on each page.

Additional print tasks (Mac OS X)

Cancel a print job (Mac OS X)

1. If the print job is currently printing, cancel it by pressing the Cancel  button on the product control panel.
-
-  **NOTE:** Pressing the Cancel  button clears the job that the product is currently processing. If more than one print job is waiting, pressing the Cancel  button clears the print job that currently appears on the product control panel.
-
2. You can also cancel a print job from a software program or a print queue.
 - **Software program:** Typically, a dialog box appears briefly on the computer screen, allowing you to cancel the print job.
 - **Mac print queue:** Open the print queue by double-clicking the product icon in the dock. Highlight the print job, and then click **Delete**.

Select the paper size (Mac OS X)

1. On the **File** menu, click the **Print** option.
2. In the **Printer** menu, select this product.
3. In the **Copies & Pages** menu, click the **Page Setup** button.
4. Select a size from the **Paper Size** drop-down list, and then click the **OK** button.
5. Click the **Print** button.

Select a custom paper size (Mac OS X)

1. On the **File** menu, click the **Print** option.
2. In the **Printer** menu, select this product.
3. In the **Copies & Pages** menu, click the **Page Setup** button.
4. From the **Paper Size** drop-down list, select the **Manage Custom Sizes** option.
5. Specify the dimensions for the page size, and then click the **OK** button.
6. Click the **Print** button.

Print watermarks (Mac OS X)


1. On the **File** menu, click the **Print** option.
2. In the **Printer** menu, select this product.
3. Open the **Watermarks** menu.
4. Click the **Watermark** checkbox.
5. Beneath the check box, use the drop-down lists to set the various watermark elements.
6. Click the **Print** button.

Create archival-quality prints

Archive print produces output that is less susceptible to toner smearing and dusting. Use archive print to create documents that you want to preserve or archive.



NOTE: Archival-quality printing is accomplished by increasing the temperature of the fuser. Because of the increased temperatures, the product prints at half-speed to avoid damage.


1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the [Service](#) menu.
3. Touch the [Archive Print](#) button, and then touch the [On](#) button.

Use HP ePrint

Use HP ePrint to print documents by sending them as an email attachment to the product's email address from any email enabled device.



NOTE: The product must be connected to a wired or wireless network and have Internet access to use HP ePrint.

1. To use HP ePrint, you must first enable HP Web Services.
 - a. From the Home screen on the product control panel, touch the Web Services  button.
 - b. Touch the [Enable Web Services](#) button.
2. From the [HP Web Services](#) menu, touch the [Display E-Mail Address](#) button to display the product's email address on the control panel.
3. Use the HP ePrintCenter Web site to define security settings and to configure default print settings for all HP ePrint jobs sent to this product.
 - a. Go to www.hpeprintcenter.com.
 - b. Click **Sign In**, and enter your HP ePrintCenter credentials or sign up for a new account.
 - c. Select your product from the list, or click **+ Add printer** to add it. To add the product, you need the printer code, which is the segment of the product email address that is before the @ symbol. You can get this code by printing the Web Services page from the product control panel.

After you have added your product, you will have the option to customize the product email address.



NOTE: This code is valid for only 24 hours from the time you enable HP Web Services. If it expires, follow the instructions to enable HP Web Services again, and obtain a new code.

- d. To prevent your product from printing unexpected documents, click **ePrint Settings**, and then click the **Allowed Senders** tab. Click **Allowed Senders Only**, and add the email addresses from which you want to allow ePrint jobs.
 - e. To set up default settings for all ePrint jobs sent to this product, click **ePrint Settings**, click **Print Options**, and select the settings that you want to use.
4. To print a document, attach it to an email message sent to the product's email address. Both the email message and the attachment will print.

Use AirPrint

Direct printing using Apple's AirPrint is supported for iOS 4.2 or later. Use AirPrint to print directly to the product from an iPad (iOS 4.2), iPhone (3GS or later), or iPod touch (third generation or later) in the following applications:

- Mail
- Photos
- Safari
- Select third-party applications

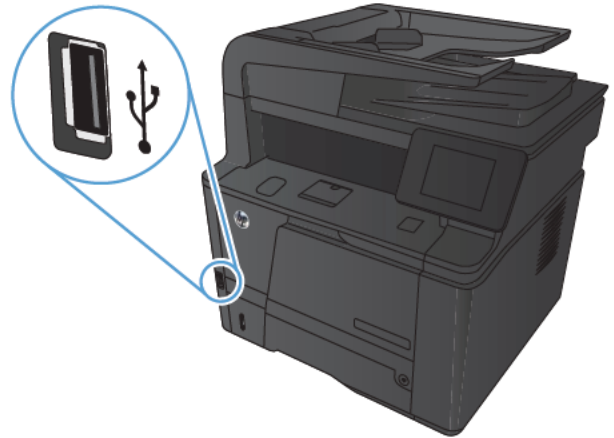
To use AirPrint, the product must be connected to a network, or be connected through a wireless direct connection. For more information about using AirPrint and about which HP products are compatible with AirPrint, go to www.hp.com/go/airprint.



NOTE: You might need to upgrade the product firmware to use AirPrint. Go to www.hp.com/support/ljm425series.

Walk-up USB printing

1. Insert the USB drive into the USB port on the front of the product.



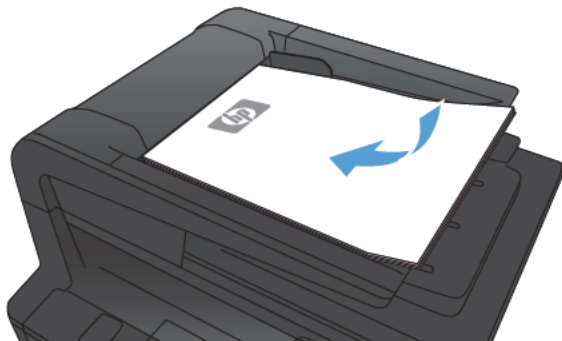
2. The **USB Flash Drive** menu opens. Touch the arrow buttons to scroll through the options.
 - **Print Documents**
 - **View and Print Photos**
 - **Scan to USB Drive**
3. To print a document, touch the **Print Documents** screen, and then touch the name of the folder on the USB drive where the document is stored. When the summary screen opens, you can touch it to adjust the settings. Touch the **Print** button to print the document.
4. To print photos, touch the **View and Print Photos** screen, and then touch the preview image for each photo that you want to print. Touch the **Done** button. When the summary screen opens, you can touch it to adjust the settings. Touch the **Print** button to print the photos.
5. Retrieve the printed job from the output bin, and remove the USB drive.

4 Copy

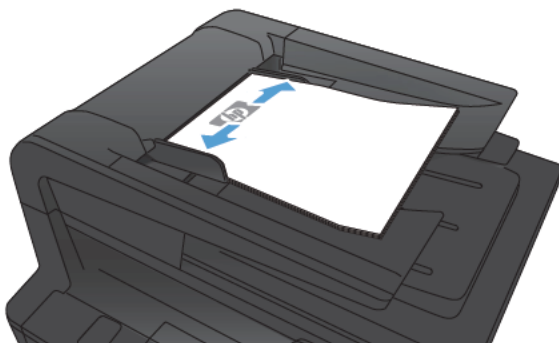
- [Make a single copy](#)
- [Make multiple copies](#)
- [Copy a multiple-page original](#)
- [Collate a copy job](#)
- [Copy on both sides \(duplex\)](#)
- [Reduce or enlarge a copy](#)
- [Copy identification cards](#)
- [Optimize copy quality](#)
- [Adjust the lightness or darkness for copies](#)
- [Copy in draft mode](#)
- [Set the paper size and type for copying on special paper](#)
- [Set new default copy settings](#)
- [Restore copy default settings](#)

Make a single copy

1. Load the document onto the scanner glass or into the document feeder.



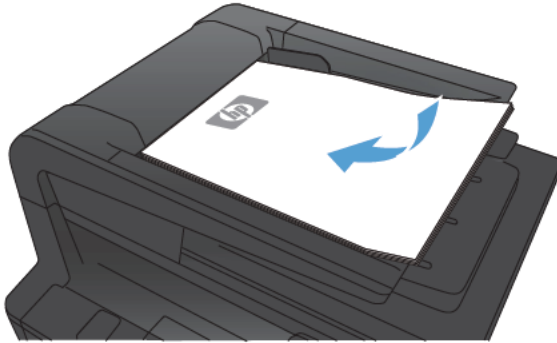
2. If you loaded the document into the document feeder, adjust the guides until they are snug against the paper.



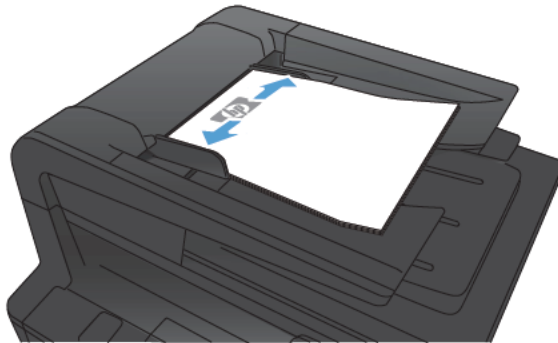
3. From the Home screen on the product control panel, touch the **Copy** button.
4. Touch the **Start Copy** button to start copying.

Make multiple copies

1. Load the document onto the scanner glass or into the document feeder.



2. If you loaded the document into the document feeder, adjust the guides until they are snug against the paper.

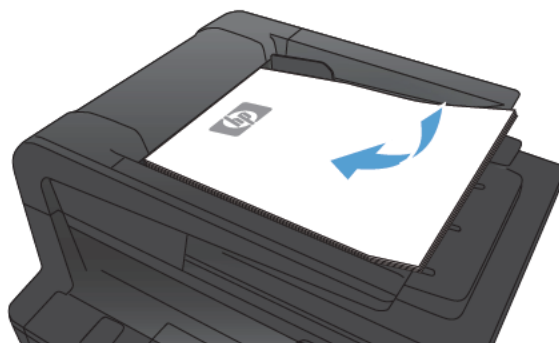


3. From the Home screen on the product control panel, touch the **Copy** button.
4. Touch the arrows to change the number of copies, or touch the existing number and type the number of copies.
5. Touch the **Start Copy** button to start copying.

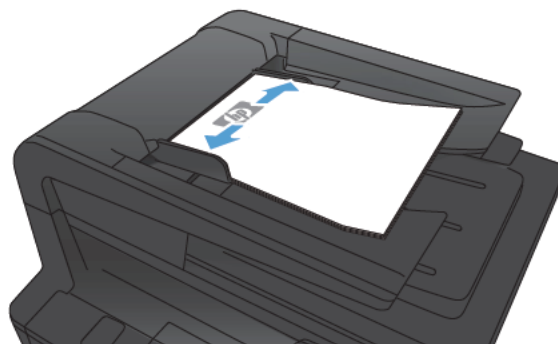
Copy a multiple-page original

1. Insert the originals into the document feeder face-up.

NOTE: The document feeder capacity is up to 50 sheets of 75 g/m² (20 lb) paper.



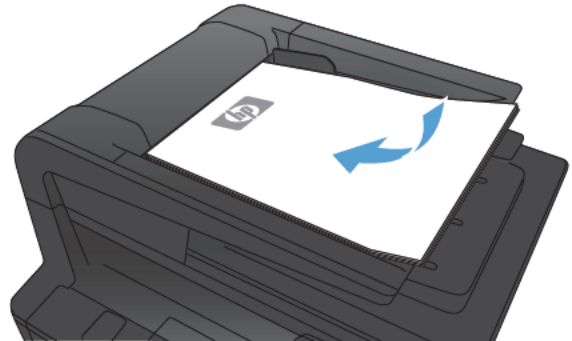
2. Adjust the guides until they are snug against the paper.



3. From the Home screen on the product control panel, touch the **Copy** button.
4. Touch the **Start Copy** button to start copying.

Collate a copy job

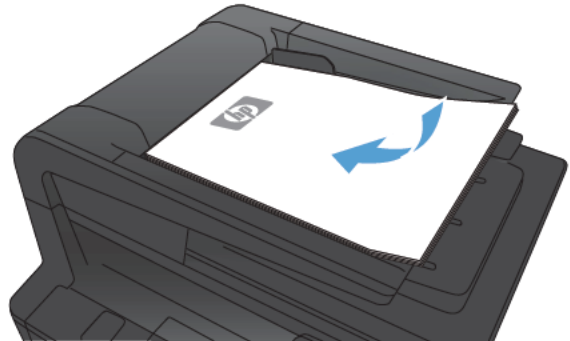
1. Load the document onto the scanner glass or into the document feeder.



2. From the Home screen on the product control panel, touch the **Copy** button.
3. Touch the **Settings** button, and then scroll to and touch the **Collation** button. Touch the arrow buttons to scroll through the options, and then touch an option to select it.
4. Touch the **Start Copy** button to start copying.

Copy on both sides (duplex)

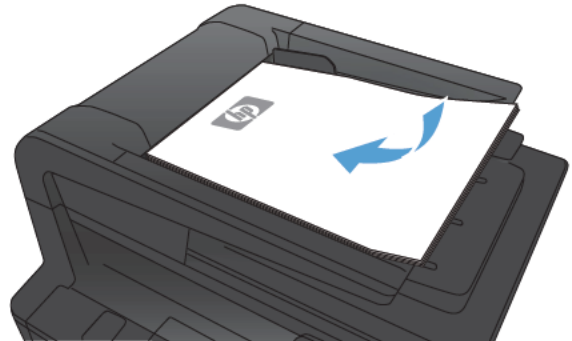
1. Load the first page of the document onto the scanner glass, or load the whole document into the document feeder.



2. From the Home screen on the product control panel, touch the **Copy** button.
3. Touch the **Settings** button, and then touch the **Two-Sided** button.
4. Select the duplexing option that you want to use. For example, to copy a two-sided original with two-sided output, select the **2-Sided to 2-Sided** option.
5. Touch the **Start Copy** button to start copying.

Reduce or enlarge a copy

1. Load the document onto the scanner glass or into the document feeder.



2. From the Home screen on the product control panel, touch the **Copy** button.
3. Touch the **Settings** button, and then touch the **Reduce/Enlarge** button. Touch the arrow buttons to scroll through the options, and then touch an option to select it.
4. Touch the **Start Copy** button to start copying.

Copy identification cards

Use the **ID Copy** feature to copy both sides of identification cards, or other small-size documents, onto the same side of one sheet of paper. The product prompts you to copy the first side and then to place the second side on a different area of the scanner glass and copy again. The product prints both images at the same time.

1. Load the document onto the rear-left corner of the scanner glass.



2. From the Home screen on the product control panel, touch the **Copy** button.
3. Touch the **ID Copy** button.
4. Touch the **Start Copy** button to start copying.
5. The product prompts you to place the next page on a different section of the scanner glass.



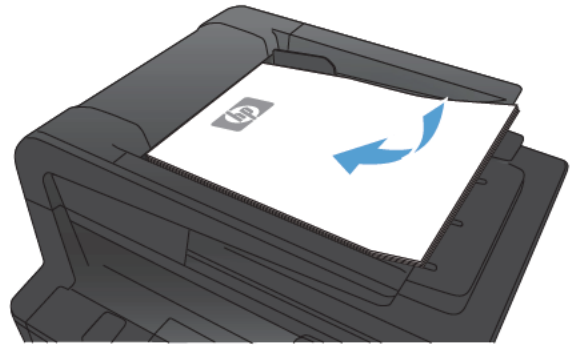
6. Touch the **OK** button if you have more pages to copy, or touch the **Done** button if this is the last page.
7. The product copies all pages onto one side of a sheet of paper.

Optimize copy quality

The following copy-quality settings are available:

- **Auto Select:** Use this setting when you are not concerned about the quality of the copy. This is the default setting.
- **Mixed:** Use this setting for documents that contain a mixture of text and graphics.
- **Text:** Use this setting for documents that contain mostly text.
- **Picture:** Use this setting for documents that contain mostly graphics.

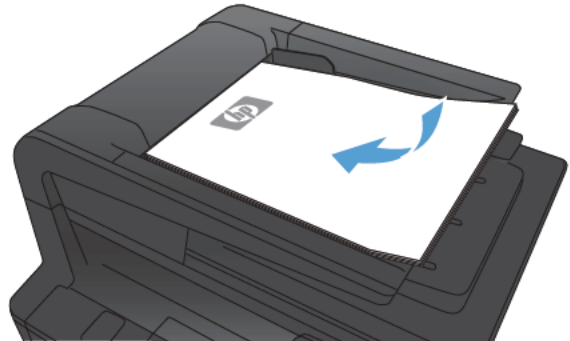
1. Load the document onto the scanner glass or into the document feeder.



2. From the Home screen on the product control panel, touch the **Copy** button.
3. Touch the **Settings** button, and then scroll to and touch the **Optimize** button. Touch the arrow buttons to scroll through the options, and then touch an option to select it.
4. Touch the **Start Copy** button to start copying.

Adjust the lightness or darkness for copies

1. Load the document onto the scanner glass or into the document feeder.



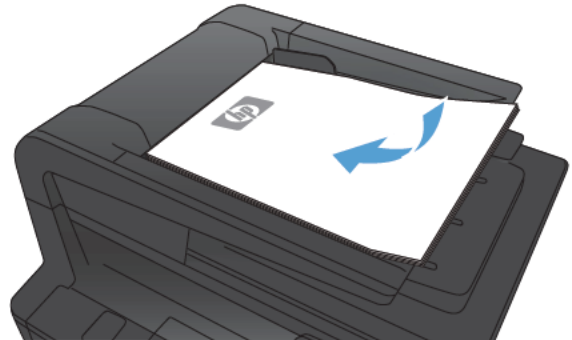
2. From the Home screen on the product control panel, touch the **Copy** button.
3. On the summary screen, touch the arrow buttons to adjust the setting.
4. Touch the **Start Copy** button to start copying.

Copy in draft mode

Using draft mode can use less toner and decrease the cost per page. However, using draft mode can also reduce print quality.

HP does not recommend the full-time use of draft mode. If draft mode is used full-time, the toner supply might outlast the mechanical parts in the toner cartridge. If print quality begins to degrade and is no longer acceptable, consider replacing the toner cartridge.

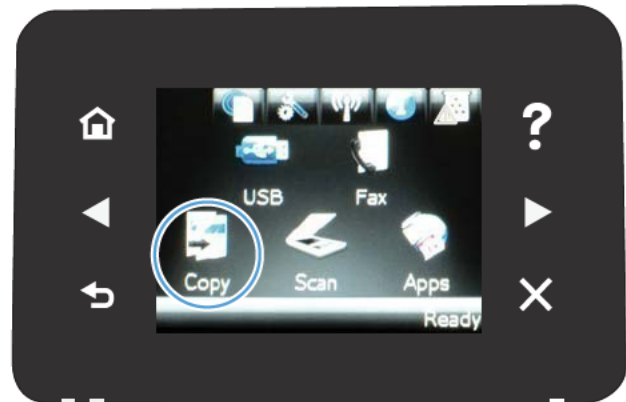
1. Load the document onto the scanner glass or into the document feeder.



2. From the Home screen on the product control panel, touch the **Copy** button.
3. Touch the **Settings** button.
4. Scroll to and touch the **Draft Mode** button.
5. Touch the **On** button.
6. Touch the **Start Copy** button to start copying.

Set the paper size and type for copying on special paper

1. From the Home screen on the product control panel, touch the **Copy** button.



2. Touch the **Settings** button, and then scroll to and touch the **Paper** button.
3. From the list of paper sizes, touch the name of the paper size that is in Tray 1.
4. From the list of paper types, touch the name of the paper type that is in Tray 1.
5. Touch the **Start Copy** button to start copying.

Set new default copy settings

You can save any combination of copy settings as the default settings to use for every job.

1. From the Home screen on the product control panel, touch the **Copy** button.

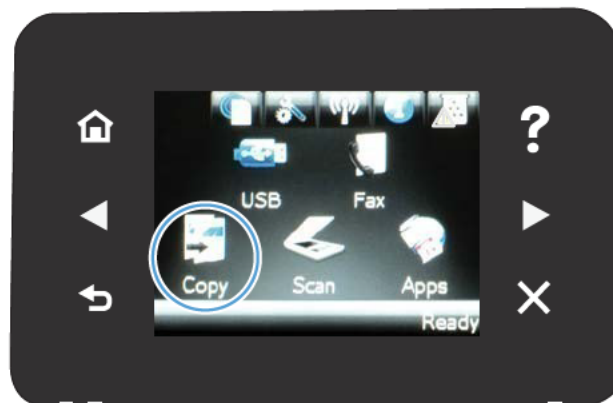


2. Touch the **Settings** button.
3. Configure the copy settings to meet your preferences, and then scroll to and touch the **Set as New Defaults** button.
4. Touch the **Yes** button.

Restore copy default settings

Use this procedure to restore the factory default copy settings.

1. From the Home screen on the product control panel, touch the **Copy** button.



2. Touch the **Settings** button.
3. Scroll to and touch the **Restore Defaults** button.
4. Touch the **OK** button to restore the defaults.

5 Scan

- [Scan by using the HP Scan software \(Windows\)](#)
- [Scan by using the HP Scan software \(Mac OS X\)](#)
- [Scan to a USB flash drive](#)
- [Set up scan to network folder and scan to email features](#)
- [Scan to a network folder](#)
- [Scan to email](#)
- [Scan by using other software](#)

Scan by using the HP Scan software (Windows)

1. Double-click the **HP Scan** icon on the computer desktop.
2. Select a scanning shortcut, and adjust the settings if necessary.
3. Click **Scan**.



NOTE: Click **Advanced Settings** to gain access to more options.

Click **Create New Shortcut** to create a customized set of settings and save it in the list of shortcuts.

Scan by using the HP Scan software (Mac OS X)

1. Open the **Applications** folder, and then click **Hewlett-Packard**. Double-click **HP Scan**.
2. Open the **HP Scan** menu and click **Preferences**. From the **Scanner** pop-up menu, select this product from the list, and click **Continue**.
3. To use the standard preset settings, which produce acceptable results for images and text, click the **Scan** button.

To use presets optimized for pictures or text documents, select a preset from the **Scanning Presets** pop-up menu. To adjust the settings, click the **Edit** button. When you are ready to scan, click the **Scan** button.
4. To scan more pages, load the next page and click **Scan**. Click **Append to List** to add the new pages to the current list. Repeat until you have scanned all the pages.
5. Click the **Save** button, and then browse to the folder on your computer where you want to save the file.



NOTE: To print the scanned images now, click the **Print** button.

Scan to a USB flash drive

1. Load the document onto the scanner glass or into the document feeder.
2. Insert a USB flash drive into the port on the front of the product.
3. From the Home screen on the product control panel, touch the [Scan](#) button.
4. Touch the [Scan to USB Drive](#) screen.
5. Touch the [Scan](#) button to scan and save the file. The product creates a folder named **HPSCANS** on the USB drive, and it saves the file in .PDF or .JPG format using an automatically generated file name.




NOTE: When the summary screen opens, you can touch it to adjust settings.

You also can change the folder name.

Set up scan to network folder and scan to email features

These scan features are not available until you use the HP Embedded Web Server to configure them. The following instructions describe setting up the scan settings.

1. From the Home screen on the product control panel, touch the Network  button to find the product IP address.
2. To open the HP Embedded Web Server, type the product IP address into the address line of a Web browser.



NOTE: You can also access the HP Embedded Web Server from the HP Device Toolbox for Windows or the HP Utility for Mac OS X.

3. Click the **Scan** tab to set up the feature.

Scan to a network folder

Use the product control panel to scan a file to a folder on the network.



NOTE: In order to use this feature, the product must be connected to a network and the scan feature must be configured using the HP Embedded Web Server.

1. Load the document onto the scanner glass or into the document feeder.
2. From the Home screen on the product control panel, touch the [Scan](#) button.
3. Touch the [Scan to Network Folder](#) item.
4. In the list of network folders, select the folder to which you want to save the file.
5. The control panel screen displays the scan settings.
 - If you want to change any of the settings, touch the [Settings](#) button, and then change the settings.
 - If the settings are correct, go to the next step.
6. Touch the [Scan](#) button to start the scan job.

Scan to email

Use the product control panel to scan a file directly to an email address. The scanned file is sent to the address as an email message attachment.



NOTE: In order to use this feature, the product must be connected to a network and the scan feature must be configured using the HP Embedded Web Server.

1. Load the document onto the scanner glass or into the document feeder.
2. From the Home screen on the product control panel, touch the [Scan](#) button.
3. Touch the [Scan to E-mail](#) item.
4. Touch the [Send to E-mail](#) item.
5. Select the [From](#) address that you want to use. This is also known as an “outgoing email profile.”



NOTE: If the PIN feature has been set up, enter the PIN and touch the [OK](#) button. However, a PIN is not required to use this feature.

6. Touch the [To](#) button and pick the address or group to which you want to send the file. Touch the [Done](#) button when finished.
7. Touch the [Subject](#) button if you would like to add a subject line
8. Touch the [Next](#) button.
9. The control panel screen displays the scan settings.
 - If you want to change any of the settings, touch the [Settings](#) button, and then change the settings.
 - If the settings are correct, go to the next step.
10. Touch the [Scan](#) button to start the scan job.

Scan by using other software

The product is TWAIN-compliant and Windows Imaging Application (WIA)-compliant. The product works with Windows-based programs that support TWAIN-compliant or WIA-compliant scanning devices and with Macintosh-based programs that support TWAIN-compliant scanning devices.

While you are in a TWAIN-compliant or WIA-compliant program, you can gain access to the scanning feature and scan an image directly into the open program. For more information, see the Help file or the documentation that came with your TWAIN-compliant or WIA-compliant software program.

Scan from a TWAIN-compliant program

Generally, a software program is TWAIN-compliant if it has a command such as **Acquire**, **File Acquire**, **Scan**, **Import New Object**, **Insert from**, or **Scanner**. If you are unsure whether the program is compliant or you do not know what the command is called, see the software program Help or documentation.

When scanning from a TWAIN-compliant program, the HP Scan software program might start automatically. If the HP Scan program starts, you can make changes while previewing the image. If the program does not start automatically, the image goes to the TWAIN-compliant program immediately.

Start the scan from within the TWAIN-compliant program. See the software program Help or documentation for information about the commands and steps to use.

Scan from a WIA-compliant program

WIA is another way to scan an image directly into a software program. WIA uses Microsoft software to scan, instead of the HP Scan software.

Generally, a software program is WIA-compliant if it has a command such as **Picture/From Scanner or Camera** in the Insert or File menu. If you are unsure whether the program is WIA-compliant, see the software program Help or documentation.

Start the scan from within the WIA-compliant program. See the software program Help or documentation for information about the commands and steps to use.


-Or-

From the Windows control panel, in the **Cameras and Scanner** folder (located inside the **Hardware and Sound** folder for Windows Vista and Windows 7), double-click the product icon. This opens the standard Microsoft WIA Wizard, which enables you to scan to a file.

6 Fax

- [Connect fax to a telephone line](#)
- [Set up fax with a telephone answering machine](#)
- [Set up fax with an extension phone](#)
- [Setup for stand-alone fax](#)
- [Configure the fax time, date, and header](#)
- [Use special characters in fax headers](#)
- [Use the phone book](#)
- [Configure send fax settings](#)
- [Configure receive fax settings](#)
- [Set fax polling](#)
- [Use fax](#)
- [Solve fax problems](#)

Connect fax to a telephone line

1. Connect the telephone cable to the line port  on the product and to the telephone jack on the wall.

The product is an analog device. HP recommends using the product on a dedicated analog telephone line.




NOTE: Some countries/regions might require an adapter to the phone cord that came with the product.

Set up fax with a telephone answering machine


- Set the product rings-to-answer setting for at least one ring more than the number of rings for which the answering machine is set.
- If an answering machine is connected to the same telephone line but on a different jack (in another room, for example), it might interfere with the product's ability to receive faxes.

Set up fax with an extension phone

With this setting turned on, you can alert the product to pick up the incoming fax call by pressing 1-2-3 sequentially on the telephone keypad. The default setting is **On**. Turn this setting off only if you use pulse dialing or if you have a service from your telephone company that also uses the 1-2-3 sequence. The telephone company service does not work if it conflicts with the product.

1. From the Home screen on the product control panel, touch the Setup  button.
2. Scroll to and touch the **Fax Setup** menu.
3. Scroll to and touch the **Advanced Setup** button.
4. Scroll to and touch the **Extension Phone** button, and touch the **On** button.

Setup for stand-alone fax

1. Unpack and set up the product.
2. From the Home screen on the product control panel, touch the Setup  button.
3. Touch the **Fax Setup** menu.
4. Touch the **Fax Set-Up Utility** button.
5. Follow the on-screen prompts and select the appropriate response for each question.



NOTE: The maximum number of characters for the fax number is 20.




NOTE: The maximum number of characters for the fax header is 25.

Configure the fax time, date, and header

Use the control panel

To use the control panel to set the date, time, and header, complete the following steps:

1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the **Fax Setup** menu.
3. Touch the **Basic Setup** menu.
4. Scroll to and touch the **Time/Date** button.
5. Select the 12-hour clock or 24-hour clock.
6. Use the keypad to enter the current time, and then touch the **OK** button.
7. Select the date format.
8. Use the keypad to enter the current date, and then touch the **OK** button.
9. Touch the **Fax Header** menu.
10. Use the keypad to enter your fax number, and then touch the **OK** button.



NOTE: The maximum number of characters for the fax number is 20.

11. Use the keypad to enter your company name or header, and then touch the **OK** button.



NOTE: The maximum number of characters for the fax header is 25.

Use the HP Fax Setup Wizard

If you did not complete the fax setup process at the time you installed the software, you can complete it at any time by using the HP Fax Setup Wizard.

1. Click **Start**, and then click **Programs**.
2. Click **HP**, click the name of the product, and then click **HP Fax Setup Wizard**.
3. Follow the onscreen instructions in the HP Fax Setup Wizard to configure the fax settings.

Use special characters in fax headers

When using the control panel to enter your name in the header or to enter a name for a one-touch key, speed-dial entry, or group-dial entry, touch the **123** button to open a keypad that contains special characters.

Use the phone book

You can store frequently dialed fax numbers (up to 120 entries) either as individual fax numbers or as groups of fax numbers.

Use the control panel to create and edit the fax phone book

1. From the Home screen on the product control panel, touch the **Fax** button.



2. Touch the **Fax Menu** button.
3. Touch the **Phone Book Setup** button.
4. Touch the **Individual Setup** button to create a speed dial entry.
5. Touch an unassigned number from the list.
6. Use the keypad to enter a name for the entry, and then touch the **OK** button.
7. Use the keypad to enter the fax number for the entry, and then touch the **OK** button.

Delete phone book entries

You can delete all phone book entries that are programmed in the product.

CAUTION: After phone book entries are deleted, they cannot be recovered.

1. From the Home screen on the product control panel, touch the **Fax** button.



2. Touch the **Fax Menu** button.
3. Touch the **Phone Book Setup** button.
4. Touch the **Delete Entry** button. Or, to delete all the entries, touch the **Delete All Entries** button.
5. Touch the entry that you want to delete.
6. Touch the **OK** button to confirm the deletion.

Create and edit speed-dial entries

1. From the Home screen on the product control panel, touch the **Fax** button.



2. Touch the **Fax Menu** button.
3. Touch the **Phone Book Setup** button.
4. Touch the **Individual Setup** button.
5. Touch an unassigned number from the list.

6. Use the keypad to enter a name for the entry, and then touch the **OK** button.
7. Use the keypad to enter the fax number for the entry, and then touch the **OK** button.

Delete speed-dial entries

1. From the Home screen on the product control panel, touch the **Fax** button.
2. Touch the **Fax Menu** button.
3. Touch the **Phone Book Setup** button.
4. Touch the **Delete Entry** button. Or, to delete all the entries, touch the **Delete All Entries** button.
5. Touch the entry that you want to delete.
6. Touch the **OK** button to confirm the deletion.

Create and edit group-dial entries

1. Create an individual entry for each fax number that you want in the group.
 - a. From the Home screen on the product control panel, touch the **Fax** button.
 - b. Touch the **Fax Menu** button.
 - c. Touch the **Phone Book Setup** button.
 - d. Touch the **Individual Setup** button.
 - e. Touch an unassigned number from the list.
 - f. Use the keypad to enter a name for the entry, and then touch the **OK** button.
 - g. Use the keypad to enter the fax number for the entry, and then touch the **OK** button.
2. From the **Phone Book Setup** menu, touch the **Group Setup** button.
3. Touch an unassigned number from the list.
4. Use the keypad to enter a name for the group, and then touch the **OK** button.
5. Touch the name of each individual entry that you want to include in the group. When you are finished, touch the **Done Selecting** button.

Delete group-dial entries

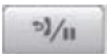


1. From the Home screen on the product control panel, touch the **Fax** button.
2. Touch the **Fax Menu** button.
3. Touch the **Phone Book Setup** button.
4. Touch the **Delete Entry** button. Or, to delete all the entries, touch the **Delete All Entries** button.

5. Touch the entry that you want to delete.
6. Touch the **OK** button to confirm the deletion.

Configure send fax settings

Set special dialing symbols and options


You can insert pauses into a fax number that you are dialing. Pauses are often needed when dialing internationally or connecting to an outside line.

Special symbol	Button	Description
Dialing pause		The Redial/Pause button is available on the control panel keypad for entering a fax number. You can also touch the comma button to insert a dialing pause.
Pause for dial tone		The W button is available only when you are entering the fax number for a phone book entry. This character causes the product to wait for a dial tone before dialing the remainder of the telephone number.
Hook flash		The R button is available only when you are entering the fax number for a phone book entry. This character causes the product to insert a hook flash.

Set a dialing prefix

A dial prefix is a number or group of numbers that are automatically added to the beginning of every fax number you enter at the control panel or from the software. The maximum number of characters for a dial prefix is 50.


The default setting is **Off**. You might want to turn this setting on and enter a prefix if, for example, you have to dial a number such as 9 to get a telephone line outside of your company telephone system. While this setting is active, you can dial a fax number without the dial prefix by using manual dial.

1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the **Fax Setup** menu.
3. Touch the **Basic Setup** menu.
4. Scroll to and touch the **Dial Prefix** button, and then touch the **On** button.
5. Use the keypad to enter the prefix, and then touch the **OK** button. You can use numbers, pauses, and dialing symbols.

Set the dial tone detection

Normally, the product begins dialing a fax number immediately. If you are using the product on the same line as your telephone, turn on the detect-dial-tone setting. This prevents the product from sending a fax while someone is on the telephone.

The factory-set default for detect dial tone is **On** for France and Hungary, and **Off** for all other countries/regions.


1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the **Fax Setup** menu.
3. Touch the **Advanced Setup** menu.
4. Scroll to and touch the **Detect Dial Tone** button, and then touch the **On** button.

Tone dial or pulse dial

Use this procedure to set the product to tone-dialing or pulse-dialing mode. The factory-set default is **Tone**. Do not change this setting unless you know that the telephone line cannot use tone dialing.



NOTE: The pulse-dialing option is not available in all countries/regions.


1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the **Fax Setup** menu.
3. Touch the **Advanced Setup** menu.
4. Scroll to and touch the **Dialing Mode** button, and then touch the **Tone** or **Pulse** button.

Set autore dial and the time between redials

If the product was unable to send a fax because the receiving fax machine did not answer or was busy, the product attempts to redial based on the redial-on-busy, redial-on-no-answer, and redial-on-communication-error options.


Set the redial-on-busy option

If this option is on, the product redials automatically if it receives a busy signal. The factory-set default for the redial-on-busy option is **On**.

1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the **Fax Setup** menu.
3. Touch the **Advanced Setup** menu.
4. Scroll to and touch the **Redial if Busy** button, and then touch the **On** button.


Set the redial-on-no-answer option

If this option is on, the product redials automatically if the receiving machine does not answer. The factory-set default for the redial-on-no-answer option is **Off**.

1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the **Fax Setup** menu.
3. Touch the **Advanced Setup** menu.
4. Scroll to and touch the **Redial if No Answer** button, and then touch the **On** button.

Set the redial-on-communication-error option

If this option is on, the product redials automatically if some sort of communication error occurs. The factory-set default for the redial-on-communication-error option is **On**.


1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the **Fax Setup** menu.
3. Touch the **Advanced Setup** menu.
4. Scroll to and touch the **Redial if Comm. Error** button, and then touch the **On** button.

Set light/dark and resolution

Set the default light/dark (contrast) setting

The contrast affects the lightness and darkness of an outgoing fax as it is being sent.

The default light/dark setting is the contrast that is normally applied to items that are being faxed. The slider is set to the middle as the default setting.

1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the **Fax Setup** menu.
3. Touch the **Advanced Setup** menu.
4. Touch the **Lighter/Darker** button, and then touch one of the arrows to adjust the slider.

Set resolution settings




NOTE: Increasing the resolution increases the fax file size. Larger faxes increase the send time and could exceed the available memory in the product.

Use this procedure to change the default resolution for all fax jobs to one of the following settings:

- **Standard:** This setting provides the lowest quality and the fastest transmission time.
- **Fine:** This setting provides a higher resolution quality than **Standard** that is usually appropriate for text documents.
- **Superfine:** This setting is best used for documents that mix text and images. The transmission time is slower than the **Fine** setting but faster than the **Photo** setting.
- **Photo:** This setting produces the best images, but greatly increases the transmission time.

The factory-set default resolution setting is **Fine**.

Set the default resolution setting


1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the **Fax Setup** menu.
3. Touch the **Advanced Setup** menu.
4. Touch the **Fax Resolution** button, and then touch one of the options.

Set billing codes

If the billing codes feature is on, the product prompts you to enter a billing code for each fax. The product increases the billing code count for each sent fax page. This includes all types of faxes except for poll-received, fax-forwarded, or computer-downloaded faxes. For an undefined group or a group-dial fax, the product increases the billing code count for each successful fax that is sent to each destination.

The factory-set default for the billing-code setting is **Off**. The billing code can be any number from 1 through 250.

Set the billing-code setting

1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the **Fax Setup** menu.
3. Touch the **Advanced Setup** menu.
4. Scroll to and touch the **Billing Codes** button, and then touch the **On** button.

Use billing codes

1. Load the document in the document feeder or on the scanner glass.
2. From the Home screen on the product control panel, touch the **Fax** button.
3. Enter the fax number, or select a speed-dial or group-dial entry.
4. Touch the **Start Fax** button.
5. Enter the billing code, and then touch the **OK** button.

Print the billing-code report

The billing-code report is a printed list of all the fax billing codes and the total number of faxes billed to each code.



NOTE: After the product prints this report, it deletes all billing data.

1. From the Home screen on the product control panel, touch the **Fax** button.
2. Touch the **Fax Menu** button.
3. Touch the **Fax Reports** button.
4. Scroll to and touch the **Print Billing Report** button.

Configure receive fax settings

Set fax forwarding

You can set your product to forward incoming faxes to another fax number. When the fax arrives at your product, it is stored in the memory. The product then dials the fax number that you have specified and sends the fax. If the product cannot forward a fax because of an error (for example, the number is busy) and repeated redial attempts are unsuccessful, your product prints the fax.

If the product runs out of memory while receiving a fax, it terminates the incoming fax and only forwards the pages and partial pages that have been stored in the memory.

When it is using the fax-forwarding feature, the product (rather than the computer) must be receiving the faxes, and the answer mode must be set to [Automatic](#).


1. From the Home screen on the product control panel, touch the [Fax](#) button.
2. Touch the [Fax Menu](#) button.
3. Touch the [Receive Options](#) button.
4. Touch the [Forward Fax](#) button, and touch the [On](#) button.
5. Use the keypad to enter the fax-forwarding number, and then touch the [OK](#) button.

Set the answer mode

Depending on the situation, set the product answer mode to [Automatic](#), [TAM](#), [Fax/Tel](#), or [Manual](#). The factory-set default is [Automatic](#).

- [Automatic](#): The product answers incoming calls after a specified number of rings or upon recognition of special fax tones.
- [TAM](#): The product does not automatically answer the call. Instead, it waits until it detects the fax tone.
- [Fax/Tel](#): The product answers incoming calls immediately. If it detects the fax tone, it processes the call as a fax. If it does not detect the fax tone, it creates an audible ring to alert you to answer the incoming voice call.
- [Manual](#): The product never answers calls. You must start the fax-receiving process yourself, either by touching the [Start Fax](#) button on the control panel or by picking up a telephone that is connected to that line and dialing 1-2-3.

To set or change the answer mode, complete the following steps:

1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the [Fax Setup](#) menu.
3. Touch the [Basic Setup](#) menu.
4. Scroll to and touch the [Answer Mode](#) button, and then touch the name of the option that you want to use.

Block or unblock fax numbers

If you do not want to receive faxes from specific people or businesses, you can block as many as 30 fax numbers by using the control panel. When you block a fax number and someone from that number sends you

a fax, the control-panel display indicates that the number is blocked, the fax does not print, and the fax is not saved in memory. Faxes from blocked fax numbers appear in the fax activity log with a “discarded” designation. You can unblock blocked fax numbers individually or all at one time.



NOTE: The sender of a blocked fax is not notified that the fax failed.

1. From the Home screen on the product control panel, touch the **Fax** button.
2. Touch the **Fax Menu** button.
3. Touch the **Receive Options** button.
4. Touch the **Block Junk Faxes** button.
5. Touch the **Add Number** button.
6. Use the keypad to enter the fax number that you want to block, and then touch the **OK** button.

Set the number of rings-to-answer

When the answer mode is set to **Automatic**, the product rings-to-answer setting determines the number of times the telephone rings before the product answers an incoming call.


If the product is connected to a line that receives both fax and voice calls (a shared line) and that also uses an answering machine, you might need to adjust the rings-to-answer setting. The number of rings-to-answer for the product must be greater than the rings-to-answer on the answering machine. This allows the answering machine to answer the incoming call and record a message if it is a voice call. When the answering machine answers the call, the product listens to the call and automatically answers it if it detects fax tones.

The default setting for rings-to-answer is five for the U.S. and Canada, and two for other countries/regions.

Use the following table to determine the number of rings-to-answer to use.

Type of telephone line	Recommended rings-to-answer setting
Dedicated fax line (receiving only fax calls)	Set to a number of rings within the range shown on the control-panel display. (The minimum and maximum number of rings allowed varies by country/region.)
One line with two separate numbers and a ring-pattern service	One or two rings. (If you have an answering machine or computer voicemail for the other telephone number, make sure that the product is set to a greater number of rings than the answering system. Also, use the distinctive-ring feature to differentiate between voice and fax calls.)
Shared line (receiving both fax and voice calls) with only an attached telephone	Five rings or more.
Shared line (receiving both fax and voice calls) with an attached answering machine or computer voicemail	Two rings more than the answering machine or computer voicemail.

To set or change the number of rings-to-answer, use the following steps:

1. From the Home screen on the product control panel, touch the **Setup**  button.
2. Touch the **Fax Setup** menu.
3. Touch the **Basic Setup** menu.

4. Touch the [Rings to Answer](#) button.
5. Use the keypad to enter the number of rings, and then touch the [OK](#) button.

Set distinctive ring

Ring-pattern or distinctive-ring service is available through some local telephone companies. The service allows you to have more than one telephone number on a single line. Each telephone number has a unique ring pattern, so that you can answer voice calls and the product can answer fax calls.

If you subscribe to a ring-pattern service with a telephone company, you must set the product to answer the correct ring pattern. Not all countries/regions support unique ring patterns. Contact the telephone company to determine if this service is available in your country/region.




NOTE: If you do not have ring-pattern service and you change the ring-pattern settings to something other than the default, [All Rings](#), the product might not be able to receive faxes.

The settings are as follows:

- [All Rings](#): The product answers any calls that come through the telephone line.
- [Single](#): The product answers any calls that produce a single-ring pattern.
- [Double](#): The product answers any calls that produce a double-ring pattern.
- [Triple](#): The product answers any calls that produce a triple-ring pattern.
- [Double and Triple](#): The product answers any calls that produce a double-ring or triple-ring pattern.

To change ring patterns for call answering, complete the following steps:

1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the [Fax Setup](#) menu.
3. Touch the [Basic Setup](#) menu.
4. Touch the [Distinctive Ring](#) button, and then touch the name of an option.

Set notification for new fax received to computer

Use the HP Digital Fax Setup Wizard software to set up this feature. To start the software program, from the Windows **Start** menu, navigate to the program group for this product, and then click the **Digital Fax Setup Wizard** item. Use the software to set up alerts for digital fax jobs.

Use autoreduction for incoming faxes


If the fit-to-page option is turned on, the product automatically reduces long faxes up to 75% to fit the information on the default paper size (for example, the fax is reduced from legal to letter size).

If the fit-to-page option is turned off, long faxes print at full size on multiple pages. The factory-set default for incoming fax autoreduction is [On](#).


If you have the [Stamp Faxes](#) option turned on, you might also want to turn on autoreduction. This reduces the size of the incoming faxes slightly, and prevents the page-stamp from forcing a fax onto two pages.



NOTE: Make sure that the default paper size setting matches the size of the paper in the tray.

1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the [Fax Setup](#) menu.
3. Touch the [Advanced Setup](#) menu.
4. Touch the [Fit to Page](#) button, and then touch the [On](#) button.

Set fax reprint settings


1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the [Fax Setup](#) menu.
3. Touch the [Advanced Setup](#) menu.
4. Scroll to and touch the [Allow Fax Reprint](#) button, and then touch the [On](#) button.

Set the fax sounds volume

Use this setting to control the volume of the fax sounds from the control panel. You can make changes to the following sounds:


- [Alarm Volume](#)
- [Ring Volume](#)
- [Phone Line Volume](#)


Set the alarm volume, phone-line volume, and ring volume


1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the [System Setup](#) menu.
3. Touch the [Volume Settings](#) menu.
4. Touch the name of the volume setting that you want to adjust, and then touch one of the options. Repeat this step for each volume setting.

Set stamp-received faxes

The product prints the sender identification information at the top of each received fax. You can also stamp the incoming fax with your own header information to confirm the date and time that the fax was received. The factory-set default for stamp-received faxes is [Off](#).


 **NOTE:** Turning on the stamp-received setting might increase the page size and cause the product to print a second page.

 **NOTE:** This option applies only to received faxes that the product prints.

1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the [Fax Setup](#) menu.
3. Touch the [Advanced Setup](#) menu.
4. Scroll to and touch the [Stamp Faxes](#) button, and then touch the [On](#) button.

Set the private receive feature

When the private-receive feature is active, received faxes are stored in memory. A password is required to print the stored faxes.

1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the **Fax Setup** menu.
3. Touch the **Advanced Setup** menu.
4. Scroll to and touch the **Private Receive** button, and then touch the **On** button.
5. If you have not already set a system password, the product prompts you to create one.



NOTE: The system password is case-sensitive.

- a. Touch the **OK** button, and then use the keypad to enter the system password.
- b. Touch the **OK** button, confirm the password by entering it a second time, and then touch the **OK** button to save the password.

Set fax polling

If someone else has set up a fax to be polled, you can request that the fax be sent to your product. (This is known as polling another machine).

1. From the Home screen on the product control panel, touch the **Fax** button.
2. Touch the **Fax Menu** button.
3. Touch the **Receive Options** button.
4. Touch the **Polling Receive** button.
5. Use the keypad to enter the number of the fax machine that you want to poll, and then touch the **OK** button.

The product dials the other fax machine and requests the fax.

Use fax



Supported fax programs

The PC fax program that came with the product is the only PC fax program that works with the product. To continue to use a PC fax program previously installed on the computer, use the modem that is already connected to the computer; it will not function through the product modem.

Cancel a fax

Use these instructions to cancel a single fax that is currently dialing or a fax that is being transmitted or received.

Cancel the current fax

Press the Cancel  button on the control panel. Any pages that have not been transmitted are canceled. Pressing the Cancel  button also stops group-dial jobs.

Cancel a pending fax job

Use this procedure to cancel a fax job in the following situations:


- The product is waiting to redial after encountering a busy signal, an unanswered call, or a communication error.
- The fax is scheduled to be sent at a future time.


Use the following steps to cancel a fax job by using the [Fax Job Status](#) menu:

1. From the Home screen on the product control panel, touch the [Fax](#) button.
2. Touch the [Fax Menu](#) button.
3. Touch the [Send Options](#) button.
4. Touch the [Fax Job Status](#) button.
5. Touch the fax number for the job that you want to cancel.

Delete faxes from memory

Use this procedure only if you are concerned that someone else has access to your product and might try to reprint faxes from the memory.

 **CAUTION:** In addition to clearing the reprint memory, this procedure clears any fax that is currently being sent, unsent faxes that are pending redial, faxes that are scheduled to be sent at a future time, and faxes that are not printed or forwarded.

1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the [Service](#) menu.
3. Touch the [Fax Service](#) menu.
4. Touch the [Clear Saved Faxes](#) button.

Use fax on a DSL, PBX, or ISDN system


HP products are designed specifically for use with traditional analog phone services. They are not designed to work on DSL, PBX, ISDN lines, or VoIP services, but they work with the proper setup and equipment.

 **NOTE:** HP recommends discussing DSL, PBX, ISDN, and VoIP setup options with the service provider.

The HP LaserJet product is an analog device that is not compatible with all digital phone environments (unless a digital-to-analog converter is used). HP does not guarantee that the product will be compatible with digital environments or digital-to-analog converters.

DSL

A digital subscriber line (DSL) uses digital technology over standard copper telephone wires. This product is not directly compatible with those digital signals. However, if the configuration is specified during DSL setup, the signal can be separated so that some of the bandwidth is used to transmit an analog signal (for voice and fax) while the remaining bandwidth is used to transmit digital data.

 **NOTE:** Not all faxes are compatible with DSL services. HP does not guarantee that the product will be compatible with all DSL service lines or providers.

A typical DSL modem employs a filter to separate the higher frequency DSL modem communication from lower frequency analog phone and fax modem communication. It is often necessary to use a filter with analog phones and analog fax products that are connected to a telephone line used by a DSL modem. The DSL service provider usually provides this filter. Contact the DSL provider for more information or for assistance.

PBX

The product is an analog device that is not compatible in all digital phone environments. Digital-to-analog filters or converters may be needed for faxing functionality. If faxing issues occur in a PBX environment, it might be necessary to contact the PBX provider for assistance. HP does not guarantee that the product will be compatible with digital environments or digital-to-analog converters.

Contact the PBX provider for more information and for assistance.

ISDN

The product is an analog device that is not compatible in all digital phone environments. Digital-to-analog filters or converters may be needed for faxing functionality. If faxing issues occur in an ISDN environment, it might be necessary to contact the ISDN provider for assistance. HP does not guarantee that the product will be compatible with ISDN digital environments or digital-to-analog converters.

Use fax on a VoIP service

Voice over internet protocol (VoIP) services are often not compatible with fax machines unless the provider explicitly states that it supports fax over IP services.

If the product experiences problems getting a fax to work on a VoIP network, verify that all cables and settings are correct. Decreasing the fax-speed setting might allow the product to send a fax over a VoIP network.

If the VoIP provider offers a "Pass through" mode for the connection, that will offer better fax performance on VoIP. Also if the provider has "comfort noise" added to the line, fax performance can be enhanced if this feature is not enabled.

If faxing problems continue, contact the VoIP provider.

Fax memory contents are retained when there is a loss of power

The flash memory protects against data loss when a power failure occurs. Other fax devices store fax pages in either normal RAM or short-term RAM. Normal RAM immediately loses data when power is lost, while short-term RAM loses data about 60 minutes after a power failure occurs. Flash memory can maintain its data for years without power applied.

Security issues when connecting internal networks to public phone lines

The product can send and receive fax data over telephone lines that conform to public switch telephone network (PSTN) standards. The secure fax protocols make it impossible for computer viruses to be transferred from the telephone line to a computer or network.

The following product features prevent virus transmission:

- No direct connection exists between the fax line and any devices that are connected to the USB or Ethernet ports.
- The internal firmware cannot be modified through the fax connection.
- All fax communications go through the fax subsystem, which does not use Internet data-exchange protocols.

Fax from the flatbed scanner

1. Place the document face-down on the scanner glass.



2. From the Home screen on the product control panel, touch the **Fax** button.
3. Use the keypad to type the fax number.
4. Touch the **Start Fax** button.
5. The product prompts you to confirm that you are sending from the scanner glass. Touch the **Yes** button.
6. The product prompts you to load the first page. Touch the **OK** button.

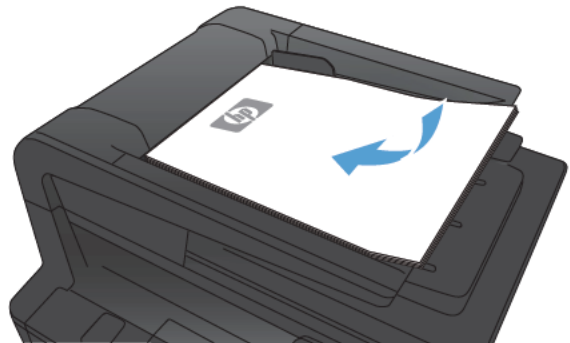
7. The product scans the first page and then prompts you to load another page. If the document has multiple pages, touch the **Yes** button. Continue this process until you have scanned all the pages.
8. When you have scanned the last page, touch the **No** button at the prompt. The product sends the fax.

Fax from the document feeder

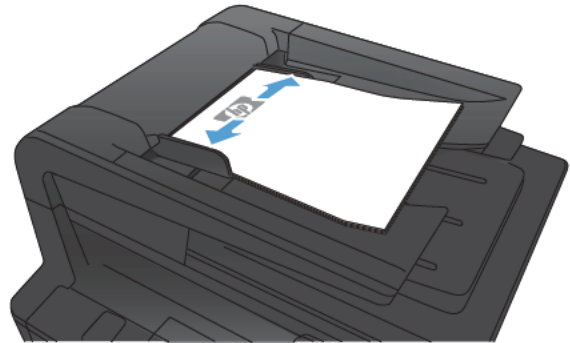
1. Insert the originals into the document feeder face-up.

NOTE: The document feeder capacity is up to 50 sheets of 75 g/m² (20 lb) paper.

CAUTION: To prevent damage to the product, do not use an original that contains correction tape, correction fluid, paper clips, or staples. Also, do not load photographs, small originals, or fragile originals into the document feeder.



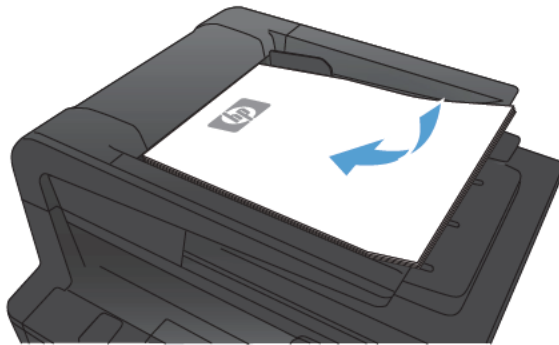
2. Adjust the paper guides until they are snug against the paper.



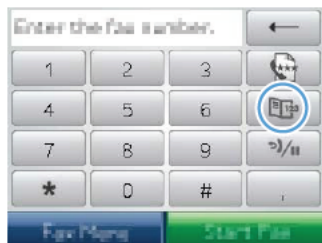
3. From the Home screen on the product control panel, touch the **Fax** button.
4. Use the keypad to type the fax number.
5. Touch the **Start Fax** button.

Use speed dials and group-dial entries

1. Load the document into the document feeder or onto the scanner glass.



2. From the Home screen on the product control panel, touch the **Fax** button.
3. On the keypad, touch the fax phone book icon.



4. Touch the name of the individual or group entry that you want to use.
5. Touch the **Start Fax** button.

Send a fax from the software

The following information provides basic instructions for sending faxes by using the software that came with the product. All other software-related topics are covered in the software Help, which can be opened from the software-program **Help** menu.

You can fax electronic documents from a computer if you meet the following requirements:

- The product is connected directly to the computer or to a network to which the computer is connected.
- The product software is installed on the computer.
- The computer operating system is one that this product supports.

Send a fax from the software

The procedure to send a fax varies according to your specifications. The most typical steps follow.

1. Click **Start**, click **Programs** (or **All Programs** in Windows XP), and then click **HP**.
2. Click the product name, and then click **Send fax**. The fax software opens.
3. Enter the fax number of one or more recipients.

4. Load the document in the document feeder.
5. Click **Send Now**.

Send a fax from a third-party software program, such as Microsoft Word

1. Open a document in a third-party program.
2. Click the **File** menu, and then click **Print**.
3. Select the fax print driver from the print driver drop-down list. The fax software opens.
4. Enter the fax number of one or more recipients.
5. Include any pages loaded at the product. This step is optional.
6. Click **Send Now**.

Send a fax by dialing from a telephone connected to the fax line

Occasionally, you might want to dial a fax number from a telephone that is connected to the same line as the product. For example, if you are sending a fax to a person whose device is in the manual receive mode, you can precede the fax with a voice call to let that person know that the fax is coming.




NOTE: The telephone must be connected to the product "telephone" port .

1. Load the document into the document feeder.
2. From the Home screen on the product control panel, touch the **Fax** button.
3. Pick up the handset of a telephone that is connected to the same line as the product. Dial the fax number by using the telephone keypad.
4. When the recipient answers, instruct the person to start the fax machine.
5. When you hear the fax tones, touch the **Start Fax** button on the control panel, wait until **Connecting** appears on the control panel display, and then hang up the telephone.

Send a fax with confirmation

You can set the product so that it prompts you to enter the fax number a second time to confirm that you are sending the fax to the correct number.

1. From the Home screen on the product control panel, touch the **Setup**  button.
2. Touch the **Fax Setup** menu.
3. Touch the **Advanced Setup** menu.
4. Scroll to and touch the **Confirm Fax Number** button, and touch the **On** button.
5. Send the fax.

Schedule a fax to be sent later

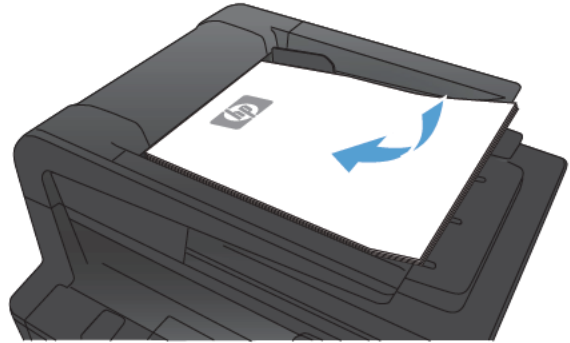
Use the product control panel to schedule a fax to be sent automatically at a future time to one or more people. When this procedure is completed, the product scans the document into memory and then returns to the Ready state.



NOTE: If the product cannot transmit the fax at the scheduled time, that information is indicated on the fax error report (if that option is turned on) or recorded in the fax activity log. The transmittal might not be initiated because the fax-sending call is not answered, or because a busy signal stops the redial attempts.

If a fax has been scheduled to be sent at a future time but it requires updating, send the additional information as another job. All faxes that are scheduled to go to the same fax number at the same time are delivered as individual faxes.

1. Load the document into the document feeder.



2. From the Home screen on the product control panel, touch the **Fax** button.
3. Touch the **Fax Menu** button.
4. Touch the **Send Options** button.
5. Touch the **Send Fax Later** button.
6. Use the keypad to enter the time of day to send the fax. Touch the **OK** button.
7. Use the keypad to enter the date to send the fax. Touch the **OK** button.
8. Use the keypad to type the fax number. Touch the **OK** button. The product scans the document and saves the file in memory until the designated time.

Send a fax combining an electronic and paper document

Use the HP Send Fax software to set up this feature. To start the software program, from the Windows **Start** menu, navigate to the program group for this product, and then click the **HP Send Fax** item. Use the software to combine the documents into a single fax job.

Use access codes, credit cards, or calling cards

To use access codes, credit cards, or calling cards, dial manually to allow for pauses and dialing codes.

Send faxes internationally

To send a fax to an international destination, dial manually to allow for pauses and international dialing codes.

Print a fax

When the product receives a fax transmission, it prints the fax (unless the private-receive feature is enabled) and also stores it automatically to flash memory.


Reprint a fax

When the [Allow Fax Reprint](#) feature is on, the product stores received faxes in memory. The product has about 3.2 MB of storage space, which holds about 250 pages.

These faxes are stored continuously. Reprinting them does not clear them from the memory.

The default setting for this feature is [Off](#).

Turn on the Allow Fax Reprint feature


1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the [Fax Setup](#) menu.
3. Touch the [Advanced Setup](#) menu.
4. Scroll to and touch the [Allow Fax Reprint](#) button, and touch the [On](#) button.

Reprint faxes

1. From the Home screen on the product control panel, touch the [Fax](#) button.
2. Touch the [Fax Menu](#) button.
3. Touch the [Receive Options](#) button.
4. Touch the [Reprint Faxes](#) button.
5. Touch the entry for the fax that you want to reprint.

Automatically print on both sides of received faxes

Use the product control panel to configure the product to print two-sided copies of received faxes.

1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the [Fax Setup](#) button.
3. Touch the [Advanced Setup](#) button.
4. Touch the [Print Duplex](#) button.
5. Touch the [On](#) button.

Receive faxes when fax tones are audible on the phone line

If you have a telephone line that receives both fax and telephone calls, and you hear fax tones when you answer the telephone, you can start the receiving process in one of two ways:

- If you are close to the product, press the [Start Fax](#) button on the control panel.
- If not, press 1-2-3 in sequence on the telephone keypad, listen for fax transmission sounds, and then hang up.



NOTE: In order for the second method to work, the [Extension Phone](#) setting must be set to [Yes](#).

Receive faxes to a computer


Print a stored fax when the private receive feature is on


To print stored faxes, you must provide the product security password. After the product prints the stored faxes, the faxes are deleted from memory.

1. From the Home screen on the product control panel, touch the [Fax](#) button.
2. Touch the [Fax Menu](#) button.
3. Touch the [Receive Options](#) button.
4. Touch the [Print Private Faxes](#) button.
5. Use the keypad to enter the product security password, and then touch the [OK](#) button.

Solve fax problems

Fax troubleshooting checklist

- Several possible fixes are available. After each recommended action, retry faxing to see if the problem is resolved.
 - For best results during fax problem solving, make sure the line from the product is plugged directly into the wall phone port. Disconnect all other devices that are connected to the product.
1. Verify that the telephone cord is plugged into the correct port on the back of the product.
 2. Check the phone line by using the fax test:
 - a. From the Home screen on the product control panel, touch the Setup  button, and then touch the [Service](#) menu.
 - b. Select the [Fax Service](#) menu.
 - c. Select the [Run Fax Test](#) option. The product prints a fax test report.
The report contains the following possible results:
 - **Pass:** The report contains all of the current fax settings for review.
 - **Fail:** The report indicates the nature of the error and contains suggestions for how to resolve the issue.
 3. Verify that the product firmware is current:
 - a. Print a configuration page from the control panel [Reports](#) menu to obtain the current firmware date code.
 - b. Go to www.hp.com.
 1. Click the **Support & Drivers** link.
 2. Click the **Download drivers and software (and firmware)** link option.
 3. In the **For product** box, type the product model number, and then click the **Go** button.
 4. Click the link for your operating system.
 5. Scroll to the Firmware section of the table.
 - If the listed version matches the version on the configuration page, you have the most current version.
 - If the versions are different, download the firmware upgrade and update the firmware on the product following the instructions onscreen.


 **NOTE:** The product must be connected to a computer with internet access to upgrade firmware.

 - Resend the fax.
 4. Verify that the fax was set up when the product software was installed.
From the computer, in the HP program folder, run the Fax Setup Utility.

5. Verify that the telephone service supports analog fax.
 - If using ISDN or digital PBX, contact your service provider for information about configuring to an analog fax line.
 - If using a VoIP service, change the [Fax Speed](#) setting to [Slow\(V.29\)](#) or disable [Fast\(V.34\)](#) from the control panel. Ask if your service provider supports fax and for the recommended fax modem speed. Some companies might require an adapter.
 - If using a DSL service, ensure that a filter is included on the phone line connection to the product. Contact the DSL service provider or purchase a DSL filter if you do not have one. If a DSL filter is installed, try another since these filters can be defective.
6. If the error persists, find more detailed problem-solving solutions in the sections that follow this one.

Fax trace report

A fax T.30 trace report has information that can help resolve fax transmission problems. If you call HP for help in resolving these problems, print a T.30 trace report before you call.

1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the [Service](#) menu.
3. Touch the [Fax Service](#) menu.
4. Touch the [Print T.30 Trace](#) button, and then touch the [Now](#) button.



NOTE: This procedure prints a report for the last fax job, successful or not. To generate a report for each unsuccessful fax job, select the [If Error](#) setting. To generate a report for each fax job, select the [At End of Call](#) setting.

Fax error report printing

Use the following instructions to print fax logs and reports:

Print all fax reports

Use this procedure to print all of the following reports at one time:

- Last Call Report
- Fax Activity Log
- Phone Book Report
- Junk Fax List
- Billing Report (when Billing Codes are turned on)
- Configuration Report
- Usage Page

1. From the Home screen on the product control panel, touch the [Fax](#) button.
2. Touch the [Fax Menu](#) button.
3. Touch the [Fax Reports](#) button.
4. Touch the [Print All fax Reports](#) button.

Print individual fax reports

1. From the Home screen on the product control panel, touch the [Fax](#) button.
2. Touch the [Fax Menu](#) button.
3. Touch the [Fax Reports](#) button.
4. Touch the name of the report that you want to print.

Set the fax error report

A fax error report is a brief report that indicates the product experienced a fax job error. You can set it to print after the following events:

- Every fax error (the factory-set default)
- Send fax error
- Receive fax error
- Never




NOTE: With this option, you will have no indication that a fax failed to be transmitted unless you print a fax activity log.

1. From the Home screen on the product control panel, touch the **Fax** button.
2. Touch the **Fax Menu** button.
3. Touch the **Fax Reports** button.
4. Touch the **Fax Error Report** button, and then touch the printing option that you want to use.

Set the fax-error-correction mode

Usually, the product monitors the signals on the telephone line while it is sending or receiving a fax. If the product detects an error during the transmission and the error-correction setting is **On**, the product can request that the portion of the fax be resent. The factory-set default for error correction is **On**.


You should turn off error correction only if you are having trouble sending or receiving a fax, and you are willing to accept the errors in the transmission. Turning off the setting might be useful when you are trying to send a fax overseas or receive one from overseas, or if you are using a satellite telephone connection.

1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the **Service** menu.
3. Touch the **Fax Service** menu.
4. Touch the **Error Correction** button, and then touch the **On** button.

Change the fax speed

The fax-speed setting is the modem protocol that the product uses to send faxes. It is the worldwide standard for full-duplex modems that send and receive data across telephone lines at up to 33,600 bits per second (bps). The factory-set default for the fax-speed setting is **Fast(V.34)**.

You should change the setting only if you are having trouble sending a fax to or receiving a fax from a particular device. Decreasing the fax speed might be useful when you are trying to send a fax overseas, or receive one from overseas, or if you are using a satellite telephone connection.

1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the **Fax Setup** menu.
3. Touch the **Advanced Setup** menu.
4. Scroll to and touch the **Fax Speed** button, and then touch the speed setting that you want to use.



Fax error messages



Alert and warning messages appear temporarily and might require you to acknowledge the message by touching the **OK** button to resume or by touching the Cancel **X** button to cancel the job. With certain warnings, the job might not complete or the print quality might be affected. If the alert or warning message is related to printing and the auto-continue feature is on, the product will attempt to resume printing the job after the warning has appeared for 10 seconds without acknowledgement.

Control panel message	Description	Recommended action
Communication error.	A fax communication error occurred between the product and the sender or receiver.	<p>Allow the product to retry sending the fax. Unplug the product telephone cord from the wall, plug in a telephone, and try making a call. Plug the product phone cord into a jack for another phone line.</p> <p>Try a different phone cord.</p> <p>Set the Fax Speed option to the Slow(V.29) setting or disable the Fast(V.34) setting.</p> <p>Turn off the Error Correction feature to prevent automatic error correction.</p> <p>NOTE: Turning off the Error Correction feature can reduce image quality.</p> <p>Print the Fax Activity Log report from the control panel to determine if the error occurs with a specific fax number.</p> <p>If the error persists, contact HP. See www.hp.com/support/lim425series or the support flyer that came in the product box.</p>
Document feeder door is open.	The cover at the top of the document feeder is open, and the product cannot send the fax.	Close the cover, and send the fax again.
Canceled fax.		
Fax is busy.	The fax line to which you were sending a fax was busy. The product has canceled sending the fax.	<p>Call the recipient to ensure that the fax machine is on and ready.</p> <p>Check that you are dialing the correct fax number.</p> <p>Check that the Redial if Busy option is enabled.</p> <p>Open the Service menu, and touch the Fax Service button. Touch the Run Fax Test button. This test verifies that the phone cord is connected to the correct port and that the phone line has a signal. The product prints a report with the results.</p> <p>If the error persists, contact HP. See www.hp.com/support/lim425series or the support flyer that came in the product box.</p>
Canceled send.		

Control panel message	Description	Recommended action
<p>Fax is busy.</p> <p>Redial pending.</p>	<p>The fax line to which you were sending a fax was busy. The product automatically redials the busy number.</p>	<p>Allow the product to retry sending the fax.</p> <p>Call the recipient to ensure that the fax machine is on and ready.</p> <p>Check that you are dialing the correct fax number.</p> <p>Open the Service menu, and touch the Fax Service button. Touch the Run Fax Test button. This test verifies that the phone cord is connected to the correct port and that the phone line has a signal. The product prints a report with the results.</p> <p>If the error persists, contact HP. See www.hp.com/support/lim425series or the support flyer that came in the product box.</p>
Fax receive error.	An error occurred while trying to receive a fax.	<p>Ask the sender to resend the fax.</p> <p>Try faxing back to the sender or another fax machine.</p> <p>Check for a dial tone on the phone line by touching the Start Fax button.</p> <p>Check that the telephone cord is securely connected by unplugging and replugging the cord.</p> <p>Make sure that you are using the telephone cord that came with the product.</p> <p>Open the Service menu, and touch the Fax Service button. Touch the Run Fax Test button. This test verifies that the phone cord is connected to the correct port and that the phone line has a signal. The product prints a report with the results.</p> <p>Decrease the fax speed. Ask the sender to resend the fax.</p> <p>Turn off error-correction mode. Ask the sender to resend the fax.</p> <p>NOTE: Turning off error-correction mode can reduce the quality of the fax image.</p> <p>Connect the product to a different phone line.</p> <p>If the error persists, contact HP. See www.hp.com/support/lim425series or the support flyer that came in the product box.</p>

Control panel message	Description	Recommended action
Fax Send error.	An error occurred while trying to send a fax.	<p>Try resending the fax.</p> <p>Try faxing to another fax number.</p> <p>Check for a dial tone on the phone line by touching the Start Fax button.</p> <p>Check that the telephone cord is securely connected by unplugging and replugging the cord.</p> <p>Make sure that you are using the telephone cord that came with the product.</p> <p>Make sure that the phone is working by disconnecting the product, plugging in a telephone to the phone line, and making a voice call.</p> <p>Connect the product to a different phone line.</p> <p>Set the fax resolution to Standard instead of the default of Fine.</p> <p>If the error persists, contact HP. See www.hp.com/support/lim425series or the support flyer that came in the product box.</p>
Fax storage is full. Canceling the fax receive.	During the fax transmission, the product ran out of memory. Only the pages that fit into memory will be printed.	Print all of the faxes, and then have the sender resend the fax. Have the sender divide the fax job into multiple jobs before resending. Cancel all fax jobs or clear the faxes from memory.
Fax storage is full. Canceling the fax receive.	The amount of available memory for storing faxes is insufficient to store an incoming fax.	<p>If you are using the Private Receive feature, print all received faxes to regain some memory.</p> <p>If you still need more memory, clear faxes from memory. Open the Service menu. In the Fax Service menu, select the Clear Saved Faxes option.</p>
Fax storage is full. Canceling the fax send.	During the fax job, the memory filled. All pages of the fax have to be in memory for a fax job to work correctly. Only the pages that fit into memory were sent.	<p>Cancel the current job. Turn the product off, and then turn it on again. Try sending the job again.</p> <p>If the error reoccurs, cancel the job and turn the product off and then on a second time. The product might not have enough memory for some jobs.</p>

Control panel message	Description	Recommended action
No dial tone.	The product could not detect a dial tone.	<p>Check for a dial tone on the phone line by touching the Start Fax button.</p> <p>Unplug the telephone cord from both the product and the wall and replug the cord.</p> <p>Make sure that you are using the telephone cord that came with the product.</p> <p>Unplug the product telephone cord from the wall, plug in a telephone, and try making a voice call.</p> <p>Make sure that the phone cord from the wall telephone jack is plugged into the line  port.</p> <p>Plug the product phone cord into a jack for another phone line.</p> <p>Check the phone line by using the Run Fax Test option from the Service menu on the control panel.</p> <p>If the error persists, contact HP. See www.hp.com/support/lim425series or the support flyer that came in the product box.</p>
No fax answer. Canceled send.	Attempts to redial a fax number failed, or the Redial if No Answer option was turned off.	<p>Call the recipient to ensure that the fax machine is on and ready.</p> <p>Check that you are dialing the correct fax number.</p> <p>Check that the redial option is enabled.</p> <p>Unplug the telephone cord from both the product and the wall and replug the cord.</p> <p>Unplug the product telephone cord from the wall, plug in a telephone, and try making a voice call.</p> <p>Make sure that the phone cord from the wall telephone jack is plugged into the line  port.</p> <p>Plug the product phone cord into a jack for another phone line.</p> <p>If the error persists, contact HP. See www.hp.com/support/lim425series or the support flyer that came in the product box.</p>



Control panel message	Description	Recommended action
No fax answer. Redial pending.	The receiving fax line did not answer. The product attempts to redial after a few minutes.	<p>Allow the product to retry sending the fax.</p> <p>Call the recipient to ensure that the fax machine is on and ready.</p> <p>Check that you are dialing the correct fax number.</p> <p>If the product continues to redial, unplug the product telephone cord from the wall, plug in a telephone, and try making a voice call.</p> <p>Make sure that the phone cord from the wall telephone jack is plugged into the line  port.</p> <p>Plug the product phone cord into a jack for another phone line.</p> <p>Try a different phone cord.</p> <p>If the error persists, contact HP. See www.hp.com/support/lim425series or the support flyer that came in the product box.</p>
No fax detected.	The product answered the incoming call but did not detect that a fax machine was calling.	<p>Allow the product to retry receiving the fax.</p> <p>Try a different phone cord.</p> <p>Make sure that the phone cord from the wall telephone jack is plugged into the line  port.</p> <p>Plug the product phone cord into a jack for another phone line.</p> <p>If the error persists, contact HP. See www.hp.com/support/lim425series or the support flyer that came in the product box.</p>

Solve problems sending faxes

- [An error message displays on the control panel](#)
- [The control panel displays a Ready message with no attempt to send the fax](#)
- [The control panel displays the message "Storing page 1" and does not progress beyond that message](#)
- [Faxes can be received, but not sent](#)
- [Product is password protected](#)
- [Unable to use fax functions from the control panel](#)
- [Unable to use speed dials](#)
- [Unable to use group dials](#)
- [Receive a recorded error message from the phone company when trying to send a fax](#)
- [Unable to send a fax when a phone is connected to the product](#)

An error message displays on the control panel

The Communication error. message appears

- Allow the product to retry sending the fax. Re-sending temporarily reduces the fax speed.
- Unplug the product telephone cord from the wall, plug in a telephone, and try making a call. Plug the product phone cord into a jack for another phone line.
- Try a different phone cord.
- From the control panel, change the **Fax Speed** option to the **Medium(V.17)** setting or **Slow(V.29)** setting.
 - a. From the Home screen on the product control panel, touch the Setup  button.
 - b. Open the **Fax Setup** menu.
 - c. Open the **Advanced Setup** menu.
 - d. Open the **Fax Speed** menu.
 - e. Select the correct setting.
- Turn off the **Error Correction** option.
 - a. From the Home screen on the product control panel, touch the Setup  button.
 - b. Open the **Service** menu.
 - c. Open the **Fax Service** menu.
 - d. Open the **Error Correction** menu.
 - e. Select the **Off** setting.




NOTE: Turning off the **Error Correction** option can reduce image quality.

- If the error persists, contact HP. See www.hp.com/support/ljm425series or the support flyer that came in the product box.

No dial tone.



- Make sure that the telephone cord is plugged into the correct port on the product.
- Make sure that the telephone cord from the product is plugged directly into the wall telephone jack.
- Check for a dial tone on the phone line by using the **Start Fax** button.
- Unplug the product telephone cord from the wall, plug in a telephone, and try making a voice call.
- Unplug the telephone cord from both the product and the wall and replug the cord.
- Make sure that you are using the telephone cord that came with the product.
- Plug the product phone cord into a jack for another phone line.
- Check the phone line by using the **Run Fax Test** option from the **Service** menu on the control panel.

- a. From the Home screen on the product control panel, touch the Setup  button.
- b. Open the [Service](#) menu.
- c. Open the [Fax Service](#) menu.
- d. Select the [Run Fax Test](#) item.

The Fax is busy. message appears

- Try sending the fax again.
- Call the recipient to ensure that the fax machine is on and ready.
- Check that you are dialing the correct fax number.
- Check for a dial tone on the phone line by using the [Start Fax](#) button.
- Make sure that the phone is working by disconnecting the product, plugging in a telephone to the phone line, and making a voice call.
- Plug the product phone cord into a jack for another phone line, and try sending the fax again.
- Try a different phone cord.
- Send the fax at a later time.
- If the error persists, contact HP. See www.hp.com/support/ljm425series or the support flyer that came in the product box.


The No fax answer. message appears

- Try to resend the fax.
- Call the recipient to ensure that the fax machine is on and ready.
- Check that you are dialing the correct fax number.
- Unplug the product telephone cord from the wall, plug in a telephone, and try making a voice call.
- Plug the product phone cord into a jack for another phone line.
- Try a different phone cord.
- Make sure that the phone cord from the wall telephone jack is plugged into the line  port.
- Check the phone line by using the [Run Fax Test](#) option from the [Service](#) menu on the control panel.
 - a. From the Home screen on the product control panel, touch the Setup  button.
 - b. Open the [Service](#) menu.
 - c. Open the [Fax Service](#) menu.
 - d. Select the [Run Fax Test](#) item.
- If the error persists, contact HP. See www.hp.com/support/ljm425series or the support flyer that came in the product box.

Document feeder paper jam

- Verify that the paper meets product size requirements. The product does not support pages longer than 381 mm (15 in) for faxing.
- Copy or print the original to letter, A4, or legal size paper, and then resend the fax.

The Fax storage is full. message appears

- Turn the product off then on.
- Print stored faxes that have not been printed.
 - a. Touch the **Fax** button, and then touch the **Fax Menu** button.
 - b. Open the **Receive Options** menu.
 - c. Select the **Print Private Faxes** item.
 - d. Provide the password when the product prompts you.
- Delete stored faxes from memory.
 - a. From the Home screen on the product control panel, touch the Setup  button.
 - b. Open the **Service** menu.
 - c. Open the **Fax Service** menu.
 - d. Select the **Clear Saved Faxes** item.
- Divide the large fax job into smaller sections, and then fax them individually.


Scanner error

- Verify that the paper meets product size requirements. The product does not support pages longer than 381 mm (15 in) for faxing.
- Copy or print the original onto letter, A4, or legal size paper and then resend the fax.

The control panel displays a Ready message with no attempt to send the fax


- Check the fax activity log for errors.
 - a. Touch the **Fax** button, and then touch the **Fax Menu** button.
 - b. Open the **Fax Reports** menu.
 - c. Open the **Fax Activity Log** menu.
 - d. Select the **Print Log Now** option.
- If a phone is connected to the product, make sure that the phone is hung up.
- Disconnect all other lines between the fax and the product.
- Connect the product directly into the wall telephone jack and resend the fax.

The control panel displays the message "Storing page 1" and does not progress beyond that message

- Delete stored faxes from memory.
 - a. From the Home screen on the product control panel, touch the Setup  button.
 - b. Open the [Service](#) menu.
 - c. Open the [Fax Service](#) menu.
 - d. Select the [Clear Saved Faxes](#) item.

Faxes can be received, but not sent

Send fax and nothing happens.

1. Check for a dial tone on the phone line by using the [Start Fax](#) button.
2. Turn the product off then on.
3. Use the control panel or the HP Fax Setup Wizard to configure the fax time, date, and fax header information.
 - a. From the Home screen on the product control panel, touch the Setup  button.
 - b. Open the [Fax Setup](#) menu.
 - c. Open the [Basic Setup](#) menu.
 - d. Open the [Fax Header](#) menu.
 - e. Enter the correct settings.
4. Verify that any extension phones on the line are hung up.
5. If using a DSL service, make sure that the phone line connection to the product includes a high-pass filter.

Product is password protected


If a network administrator has set a product password, then you must obtain the password in order to use the product fax features.

Unable to use fax functions from the control panel


- The product might be password protected. Use the HP Embedded Web Server, HP Toolbox software, or the control panel to set a password.
- If you do not know the password for the product, contact your system administrator.
- Verify with the system administrator that the fax functionality has not been disabled.

Unable to use speed dials


- Make sure that the fax number is valid.
- If an outside line requires a prefix, turn on the [Dial Prefix](#) option or include the prefix in the speed dial number.

- a. From the Home screen on the product control panel, touch the Setup  button.
- b. Open the [Fax Setup](#) menu.
- c. Open the [Basic Setup](#) menu.
- d. Open the [Dial Prefix](#) menu.
- e. Select the [On](#) setting.

Unable to use group dials

- Make sure that the fax number is valid.
- If an outside line requires a prefix, turn on the [Dial Prefix](#) option or include the prefix in the speed dial number.
 - a. From the Home screen on the product control panel, touch the Setup  button.
 - b. Open the [Fax Setup](#) menu.
 - c. Open the [Basic Setup](#) menu.
 - d. Open the [Dial Prefix](#) menu.
 - e. Select the [On](#) setting.
- Set up all entries in the group with speed dial entries.
 - a. Open an unused speed dial entry.
 - b. Enter the fax number for the speed dial.
 - c. Touch the [OK](#) button to save the speed dial.

Receive a recorded error message from the phone company when trying to send a fax

- Make sure you dial the fax number correctly, and make sure that the phone service is not blocked. For example, some phone services might prevent long distance calling.
- If an outside line requires a prefix, turn on the [Dial Prefix](#) option or include the prefix in the speed dial number.
 - a. From the Home screen on the product control panel, touch the Setup  button.
 - b. Open the [Fax Setup](#) menu.
 - c. Open the [Basic Setup](#) menu.
 - d. Open the [Dial Prefix](#) menu.
 - e. Select the [On](#) setting.



NOTE: To send a fax without a prefix, when the [Dial Prefix](#) option is turned on, send the fax manually.

- Send a fax to an international number
 - a. If a prefix is required, manually dial the telephone number with the prefix.
 - b. Enter the country/region code before dialing the phone number.

- c. Wait for pauses as you hear the tones on the phone.
- d. Send the fax manually from the control panel.

Unable to send a fax when a phone is connected to the product


- Make sure that the telephone is hung up.
- Make sure that the telephone is not being used for a voice call when faxing.
- Unplug the phone from the line, and then try sending the fax.

Solve problems receiving faxes


- [The fax does not respond](#)
- [An error message displays on the control panel](#)
- [A fax is received but does not print](#)
- [Sender receives a busy signal](#)
- [No dial tone](#)
- [Cannot send or receive a fax on a PBX line](#)

The fax does not respond



The fax has a dedicated phone line

- Set the **Answer Mode** option to the **Automatic** setting from the control panel.
 - a. From the Home screen on the product control panel, touch the Setup  button.
 - b. Open the **Fax Setup** menu.
 - c. Open the **Basic Setup** menu.
 - d. Open the **Answer Mode** menu.
 - e. Select the **Automatic** setting.

An answering machine is connected to the product


- Set the **Answer Mode** option to the **TAM** setting and plug the answering machine into the “telephone” port.
 - a. From the Home screen on the product control panel, touch the Setup  button.
 - b. Open the **Fax Setup** menu.
 - c. Open the **Basic Setup** menu.
 - d. Open the **Answer Mode** menu.
 - e. Select the **TAM** setting.

If the **TAM** setting is unavailable, set the **Answer Mode** option to the **Automatic** setting.

- Set the **Rings to Answer** setting to at least one ring more than the number of rings for which the answering machine is set.
 - a. From the Home screen on the product control panel, touch the Setup  button.
 - b. Open the **Fax Setup** menu.
 - c. Open the **Basic Setup** menu.
 - d. Open the **Rings to Answer** menu.
 - e. Select the correct setting.
- Plug the answering machine into the “telephone” port.
- If the product has a telephone handset connected, set the **Answer Mode** option to the **Fax/Tel** setting to route calls to the correct device. When detecting a voice call, the product generates a ring tone that alerts you to pick up the telephone handset.
 - a. From the Home screen on the product control panel, touch the Setup  button.
 - b. Open the **Fax Setup** menu.
 - c. Open the **Basic Setup** menu.
 - d. Open the **Answer Mode** menu.
 - e. Select the **Fax/Tel** setting.

A telephone handset is connected to the product


Set the **Answer Mode** option to the **Automatic** setting.


1. From the Home screen on the product control panel, touch the Setup  button.
2. Open the **Fax Setup** menu.
3. Open the **Basic Setup** menu.
4. Open the **Answer Mode** menu.
5. Select the **Automatic** setting.

The Answer Mode setting is set to the Manual setting

- Touch the **Start Fax** button on the product control panel.

Voice mail is available on the fax line

- Add a distinctive ring service to your telephone line and change the **Distinctive Ring** setting on the product to match the ring pattern supplied by the telephone company. Contact your telephone company for information.
 - a. From the Home screen on the product control panel, touch the Setup  button.
 - b. Open the **Fax Setup** menu.
 - c. Open the **Basic Setup** menu.

- d. Open the [Distinctive Ring](#) menu.
- e. Select the correct setting.
- Buy a dedicated line for faxing.
- Set the [Answer Mode](#) option to the [Manual](#) setting.
 - a. From the Home screen on the product control panel, touch the Setup  button.
 - b. Open the [Fax Setup](#) menu.
 - c. Open the [Basic Setup](#) menu.
 - d. Open the [Answer Mode](#) menu.
 - e. Select the [Manual](#) setting.




NOTE: You must be present to receive faxes.

The product is connected to a DSL phone service

- Check the installation and features. A DSL modem requires a high-pass filter on the phone line connection to the product. Contact your DSL service provider for a filter or buy a filter.
- Verify that the filter is plugged in.
- Replace the existing filter to make sure that it is not defective.

The product uses a fax over IP or VoIP phone service

- Set the [Fax Speed](#) option to the [Slow\(V.29\)](#) or [Medium\(V.17\)](#) setting, or disable the [Fast\(V.34\)](#) setting.
 - a. From the Home screen on the product control panel, touch the Setup  button.
 - b. Open the [Fax Setup](#) menu.
 - c. Open the [Advanced Setup](#) menu.
 - d. Open the [Fax Speed](#) menu.
 - e. Select the correct setting.
- Contact your service provider to make sure that fax is supported and for a recommended fax speed settings. Some companies might require an adapter.

An error message displays on the control panel

The No fax detected. message appears




NOTE: This error does not always refer to a missed fax. If a voice call is made to a fax number by mistake and the caller hangs up, the **No fax detected.** message appears on the control panel.

- Ask the sender to resend the fax.
- Make sure that the telephone cord from the product is plugged into the wall telephone jack.
- Try a different phone cord.


- Plug the product phone cord into a jack for another phone line.
- Make sure the telephone line and phone wall jack are active by plugging in a telephone and checking for a dial tone.
- Make sure that the telephone cord is plugged into the “line” port on the product.
- Check the phone line by running a fax test from the control panel.
- If the error persists, contact HP. See www.hp.com/support/ljm425series or the support flyer that came in the product box.

The Communication error. message appears


- Ask the sender to send the fax again or send at a later time when line conditions have improved.
- Unplug the product telephone cord from the wall, plug in a telephone, and try making a call. Plug the product phone cord into a jack for another phone line.
- Try a different phone cord.
- Set the **Fax Speed** option to the **Slow(V.29)** or **Medium(V.17)** setting, or disable the **Fast(V.34)** setting.
 - a. From the Home screen on the product control panel, touch the Setup  button.
 - b. Open the **Fax Setup** menu.
 - c. Open the **Advanced Setup** menu.
 - d. Open the **Fax Speed** menu.
 - e. Select the correct setting.
- Turn off the **Error Correction** feature to prevent automatic error correction.



NOTE: Turning off the **Error Correction** feature can reduce image quality.

- a. From the Home screen on the product control panel, touch the Setup  button.
 - b. Open the **Service** menu.
 - c. Open the **Fax Service** menu.
 - d. Open the **Error Correction** menu.
 - e. Select the **Off** setting.
- Print the **Fax Activity Log** report from the control panel to determine if the error occurs with a specific fax number.
 - a. Touch the **Fax** button, and then touch the **Fax Menu** button.
 - b. Open the **Fax Reports** menu.
 - c. Open the **Fax Activity Log** menu.
 - d. Select the **Print Log Now** option.
 - If the error persists, contact HP. See www.hp.com/support/ljm425series or the support flyer that came in the product box.

The Fax storage is full. message appears

- Turn the product off then on.
- Print all of the faxes, and then have the sender resend the fax.
- Ask the sender to divide a large fax job into smaller sections, and then fax them individually.
- Make sure that the resolution of the sending fax machine is not set to the **Photo** setting or the **Superfine** setting.
 - a. From the Home screen on the product control panel, touch the Setup  button.
 - b. Open the **Fax Setup** menu.
 - c. Open the **Advanced Setup** menu.
 - d. Open the **Fax Resolution** menu.
 - e. Select the correct setting.
- Cancel all fax jobs or clear the faxes from memory.

The Fax is busy. message appears

- The product cannot receive a fax while attempting to send one. Cancel the fax send and try sending at a later time.
- Allow the product to try sending the fax again.


A fax is received but does not print**The Private Receive feature is on**

- When the **Private Receive** feature is activated, received faxes are stored in memory. A password is required to print the stored faxes.
- Enter the password to print the fax. If you do not know the password, contact the product administrator.



NOTE: Memory errors might occur if the faxes are not printed. The product will not answer if the memory is full.

Sender receives a busy signal**A handset is connected to the product**

- Make sure the phone is hung up.
- Change the **Answer Mode** option to match the product setup.
 - a. From the Home screen on the product control panel, touch the Setup  button.
 - b. Open the **Fax Setup** menu.
 - c. Open the **Basic Setup** menu.

- d. Open the [Answer Mode](#) menu.
- e. Select the setting that matches the product setup.

Set the [Answer Mode](#) option to the [Fax/Tel](#) setting to automatically receive faxes. The [Fax/Tel](#) setting automatically detects whether the incoming transmission is a fax or a voice call and routes the call to the appropriate device.

A phone line splitter is being used

- If you are using a phone line splitter, remove the splitter and set up the phone as a downstream phone.
- Make sure the phone is hung up.
- Make sure the phone is not being used for a voice call when faxing.

No dial tone

- If using a phone line splitter, remove the phone line splitter and set up the phone as a downstream phone.

Cannot send or receive a fax on a PBX line

- If you are using a PBX phone line, contact your PBX administrator to configure an analog fax line for your product.

Solve general fax problems

- [Faxes are sending slowly](#)
- [Fax quality is poor](#)
- [Fax cuts off or prints on two pages](#)

Faxes are sending slowly

The product is experiencing poor phone line quality.

- Retry sending the fax when the line conditions have improved.
- Check with the phone service provider that the line supports fax.
- Turn off the [Error Correction](#) setting.
 - a. Open the [Setup Menu](#) menu.
 - b. Open the [Service](#) menu.
 - c. Open the [Fax Service](#) menu.
 - d. Open the [Error Correction](#) menu.
 - e. Select the [Off](#) setting.



NOTE: This can reduce image quality.

- Use white paper for the original. Do not use colors such as gray, yellow, or pink.
- Increase the [Fax Speed](#) setting.

- a. Open the [Setup Menu](#) menu.
- b. Open the [Fax Setup](#) menu.
- c. Open the [Advanced Setup](#) menu.
- d. Open the [Fax Speed](#) menu.
- e. Select the correct setting.
- Divide large fax jobs into smaller sections, and then fax them individually.
- Change the fax settings on the control panel to a lower resolution.
 - a. Open the [Setup Menu](#) menu.
 - b. Open the [Fax Setup](#) menu.
 - c. Open the [Advanced Setup](#) menu.
 - d. Open the [Fax Resolution](#) menu.
 - e. Select the correct setting.

Fax quality is poor

Fax is blurry or light.

- Increase fax resolution when sending faxes. Resolution does not affect received faxes.
 - a. Open the [Setup Menu](#) menu.
 - b. Open the [Fax Setup](#) menu.
 - c. Open the [Advanced Setup](#) menu.
 - d. Open the [Fax Resolution](#) menu.
 - e. Select the correct setting.



NOTE: Increasing resolution slows transmission speed.

- Turn on the [Error Correction](#) setting from the control panel.
 - a. Open the [Setup Menu](#) menu.
 - b. Open the [Service](#) menu.
 - c. Open the [Fax Service](#) menu.
 - d. Open the [Error Correction](#) menu.
 - e. Select the [On](#) setting.
- Check the toner cartridges and replace if necessary.
- Ask the sender to darken the contrast setting on the sending fax machine, and then resend the fax.

Fax cuts off or prints on two pages

- Set the [Default Paper Size](#) setting. Faxes print on a single size of paper based on the [Default Paper Size](#) settings.
 - a. Open the [Setup Menu](#) menu.
 - b. Open the [System Setup](#) menu.
 - c. Open the [Paper Setup](#) menu.
 - d. Open the [Default Paper Size](#) menu.
 - e. Select the correct setting.
- Set the paper type and size for the tray used for faxes.
- Turn on the [Fit to Page](#) setting to print longer length faxes on letter or A4 size paper.
 - a. Open the [Setup Menu](#) menu.
 - b. Open the [Fax Setup](#) menu.
 - c. Open the [Advanced Setup](#) menu.
 - d. Open the [Fit to Page](#) menu.
 - e. Select the [On](#) setting.



NOTE: If the [Fit to Page](#) setting is off and the [Default Paper Size](#) setting is set to letter, a legal size original prints on two pages.

7 Manage and maintain

- [Use the HP Reconfiguration Utility to change the product connection](#)
- [Set up HP Wireless Direct Printing](#)
- [Use HP Web Services applications](#)
- [Configure IP network settings](#)
- [HP Device Toolbox \(Windows\)](#)
- [HP Utility for Mac OS X](#)
- [HP Web Jetadmin](#)
- [Product security features](#)
- [Economy settings](#)
- [Print when a toner cartridge is at estimated end of life](#)
- [Store and recycle supplies](#)
- [Replacement instructions](#)
- [Memory](#)
- [Update the firmware](#)

Use the HP Reconfiguration Utility to change the product connection

If you are already using the product and you wish to change the way it is connected, use the HP Reconfiguration Utility to set up the connection. For example, you can reconfigure the product to use a different wireless address, to connect to a wired or wireless network, or change from a network connection to a USB connection. You can change the configuration without inserting the product CD. After you select the type of connection you wish to make, the program goes directly to the portion of the product setup procedure that needs to change.

The HP Reconfiguration Utility is located in the HP programs group on your computer.

Set up HP Wireless Direct Printing




NOTE: This feature is available with wireless models only.

The HP Wireless Direct Printing feature lets you print from your wireless mobile device directly to an HP Wireless Direct-enabled product without requiring connection to an established network or the Internet. Use HP Wireless Direct to print wirelessly from the following devices:

- iPhone, iPad, or iTouch using Apple AirPrint
- Mobile devices that run Android, iOS, or Symbian using the HP ePrint Home & Biz application

To set up HP Wireless Direct from the control panel, complete the following steps:


1. From the Home screen on the product control panel, touch the Setup  button.
2. Open the following menus:
 - [Network Setup](#)
 - [Wireless Menu](#)
 - [Wireless Direct Settings](#)
 - [Wireless Direct On/Off](#)



NOTE: If the [Wireless Direct Settings](#) item does not appear on the control panel, you need to upload the current version of the product firmware. To get the current version, go to www.hp.com, enter the HP product number in the search box, select the specific product model, and then click the **Software & Driver Downloads** link.

3. Touch the [On](#) menu item. The product saves the setting and then returns the control panel to the [Wireless Direct Settings](#) menu.

Use HP Web Services applications


1. From the Home screen on the product control panel, touch the Web Services  button.
2. Touch the [Enable Web Services](#) button.

After you download an application from the HP ePrintCenter Web site, it is available in the [Apps](#) menu on the product control panel. This process enables both HP Web Services and the [Apps](#) menu.

Configure IP network settings

View or change network settings

Use the HP Embedded Web Server to view or change IP configuration settings.

1. From the Home screen on the product control panel, touch the Network  button to find the product IP address.
2. To open the HP Embedded Web Server, type the IP address into the address line of a Web browser.




NOTE: You can also access the HP Embedded Web Server from the HP Device Toolbox for Windows or the HP Utility for Mac OS X.

3. Click the **Networking** tab to obtain network information. You can change settings as needed.


Manually configure IPv4 TCP/IP parameters from the control panel

Use the control-panel menus to manually set an IPv4 address, subnet mask, and default gateway.

1. From the Home screen on the product control panel, touch the Setup  button.
2. Scroll to and touch the **Network Setup** menu.
3. Touch the **TCP/IP Config** menu, and then touch the **Manual** button.
4. Use the numeric keypad to enter the IP address, and touch the **OK** button. Touch the **Yes** button to confirm.
5. Use the numeric keypad to enter the subnet mask, and touch the **OK** button. Touch the **Yes** button to confirm.
6. Use the numeric keypad to enter the default gateway, and touch the **OK** button. Touch the **Yes** button to confirm.

Rename the product on a network

If you want to rename the product on a network so that it can be uniquely identified, use the HP Embedded Web Server.

1. From the Home screen on the product control panel, touch the Network  button to find the product IP address.
2. To open the HP Embedded Web Server, type the product IP address into the address line of a Web browser.



NOTE: You can also access the HP Embedded Web Server from the HP Device Toolbox for Windows or the HP Utility for Mac OS X.

3. Open the **System** tab.

4. On the **Device Information** page, the default product name is in the **Device Status** field. You can change this name to uniquely identify this product.



NOTE: Completing the other fields on this page is optional.

5. Click the **Apply** button to save the changes.

Link speed and duplex settings



NOTE: This information applies only to Ethernet networks. It does not apply to wireless networks.


The link speed and communication mode of the print server must match the network hub. For most situations, leave the product in automatic mode. Incorrect changes to the link speed and duplex settings might prevent the product from communicating with other network devices. If you need to make changes, use the product control panel.



NOTE: The setting must match with the network product to which you are connecting (a network hub, switch, gateway, router, or computer).



NOTE: Making changes to these settings causes the product to turn off and then on. Make changes only when the product is idle.

1. From the Home screen on the product control panel, touch the Setup  button.
2. Scroll to and touch the **Network Setup** menu.
3. Touch the **Link Speed** menu.
4. Select one of the following options.

Setting	Description
Automatic	The print server automatically configures itself for the highest link speed and communication mode allowed on the network.
10T Full	10 Mbps, full-duplex operation
10T Half	10 megabytes per second (Mbps), half-duplex operation
100TX Full	100 Mbps, full-duplex operation
100TX Half	100 Mbps, half-duplex operation

5. Touch the **OK** button. The product turns off and then on.

HP Device Toolbox (Windows)

Use the HP Device Toolbox for Windows to view or change product settings from your computer. This tool opens the HP Embedded Web Server for the product.



NOTE: This tool is available only if you performed a full installation when you installed the product.

1. Click the **Start** button, and then click the **Programs** item.
2. Click your HP product group, and then click the **HP Device Toolbox** item.

Tab or section	Description
Home tab Provides product, status, and configuration information.	<ul style="list-style-type: none"> • Device Status: Shows the product status and shows the approximate percent life remaining of HP supplies. • Supplies Status: Shows the approximate percent life remaining of HP supplies. Actual supply life remaining can vary. Consider having a replacement supply available to install when print quality is no longer acceptable. The supply does not need to be replaced unless the print quality is no longer acceptable. • Device Configuration: Shows the information found on the product configuration page. • Network Summary: Shows the information found on the product network configuration page. • Reports: Allows you to print the configuration and supplies status pages that the product generates. • Event Log: Shows a list of all product events and errors.
System tab Provides the ability to configure the product from your computer.	<ul style="list-style-type: none"> • Device Information: Provides basic product and company information. • Paper Setup: Allows you to change the paper-handling defaults for the product. • Print Quality: Allows you to change the print quality defaults for the product, including calibration settings. • Paper Types: Allows you to configure print modes that correspond to the paper types that the product accepts. • System Setup: Allows you to change the system defaults for the product. • Service: Allows you to start the cleaning procedure on the product. • Product Security: Allows you to set or change the product password. • Save and Restore: Save the current settings for the product to a file on the computer. Use this file to load the same settings onto another product or to restore these settings to this product at a later time. <p>NOTE: The System tab can be password-protected. If this product is on a network, always consult with the administrator before changing settings on this tab.</p>
Print tab Provides the ability to change default print settings from your computer.	<ul style="list-style-type: none"> • Printing: Change the default product print settings, such as number of copies and paper orientation. These are the same options that are available on the control panel. • PCL5c: View and change the PCL5c settings. • PostScript: Turn off or on the Print PS Errors feature.

Tab or section	Description
Networking tab Provides the ability to change network settings from your computer.	Network administrators can use this tab to control network-related settings for the product when it is connected to an IP-based network. It also allows the network administrator to set up Wireless Direct functionality. This tab does not appear if the product is directly connected to a computer.
HP Web Services tab	Use this tab to set up and use various Web tools with the product.

HP Utility for Mac OS X

Use the HP Utility for Mac OS X to view or change product settings from your computer. This tool opens the HP Embedded Web Server for the product.

You can use the HP Utility when the product is connected with a USB cable or is connected to a TCP/IP-based network.

Open the HP Utility

▲ From the dock, click **HP Utility**.

-or-

From **Applications**, click **Hewlett Packard**, and then click **HP Utility**.

HP Utility features

Use the HP Utility software to perform the following tasks:

- Obtain information about supplies status.
- Obtain information about the product, such as the firmware version and the serial number.
- Print a configuration page.
- Configure the paper type and size for the tray.
- Transfer files and fonts from the computer to the product.
- Update the product firmware.
- Change the Bonjour name for the product on the Bonjour network.
- Display the color usage page.

HP Web Jetadmin

HP Web Jetadmin is an award-winning, industry-leading tool for efficiently managing a wide variety of networked HP devices, including printers, multifunction products, and digital senders. This single solution allows you to remotely install, monitor, maintain, troubleshoot, and secure your printing and imaging environment — ultimately increasing business productivity by helping you save time, control costs, and protect your investment.

HP Web Jetadmin updates are periodically made available to provide support for specific product features. Visit www.hp.com/go/webjetadmin and click the **Self Help and Documentation** link to learn more about updates.



NOTE: Device plug-ins can be installed into HP Web Jetadmin to provide support for specific product features.



NOTE: Browsers must be Java-enabled. Web Jetadmin is not supported for Mac OS X.

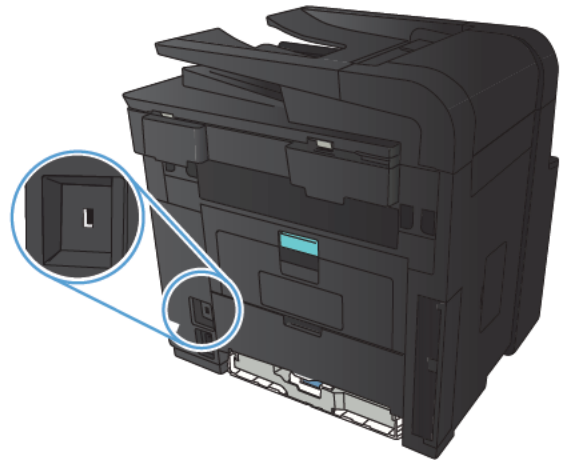
Product security features

The product supports security standards and recommended protocols that help you keep the product secure, protect critical information on your network, and simplify the way you monitor and maintain the product.

For in-depth information about HP's secure imaging and printing solutions, visit www.hp.com/go/secureprinting. The site provides links to white papers and FAQ documents about security features.


Lock the product

1. You can attach a security cable to the slot on the back of the product.




Set or change the product password

Use the HP Embedded Web Server to set a password or change an existing password for a product on a network.

1. From the Home screen on the product control panel, touch the Network  button to find the product IP address.
2. To open the HP Embedded Web Server, type the product IP address into the address line of a Web browser.

 **NOTE:** You can also access the HP Embedded Web Server from the HP Device Toolbox for Windows or the HP Utility for Mac OS X.

3. Click the **Settings** tab, and click the **Security** link.

 **NOTE:** If a password has previously been set, you are prompted to type the password. Type the password, and then click the **Apply** button.

4. Type the new password in the **New Password** box and in the **Verify password** box.
5. At the bottom of the window, click the **Apply** button to save the password.

Economy settings

Print with EconoMode

This product has an EconoMode option for printing drafts of documents. Using EconoMode can use less toner. However, using EconoMode can also reduce print quality.


HP does not recommend the full-time use of EconoMode. If EconoMode is used full-time, the toner supply might outlast the mechanical parts in the toner cartridge. If print quality begins to degrade and is no longer acceptable, consider replacing the toner cartridge.



NOTE: If this option is not available in your print driver, you can set it using the HP Embedded Web Server

1. From the software program, select the **Print** option.
2. Select the product, and then click the **Properties** or **Preferences** button.
3. Click the **Paper/Quality** tab.
4. Click the **EconoMode** check box.


Set the sleep delay

1. From the Home screen on the product control panel, touch the Setup  button.
2. Open the following menus:
 - [System Setup](#)
 - [Energy Settings](#)
 - [Sleep Delay](#)
3. Select the time for the sleep delay.



NOTE: The default value is [15 Minutes](#).

Set the auto power down interval

1. From the Home screen on the product control panel, touch the Setup  button.
2. Open the following menus:
 - [System Setup](#)
 - [Energy Settings](#)
 - [Auto Power Down](#)
 - [Sleep/Auto Off After](#)

3. Select the time for the power-down delay.



NOTE: The default value is [30 Minutes](#).

4. The product automatically wakes from the auto power-down mode when it receives jobs or when you press a button on the control panel. You can change which events cause the product to wake. Open the following menus:
 - [System Setup](#)
 - [Energy Settings](#)
 - [Auto Power Down](#)
 - [Wake Events](#)

To turn off a wake event, select the event and then select the [No](#) option.

Print when a toner cartridge is at estimated end of life

Black Low: The product indicates when a toner cartridge level is low. Actual toner cartridge life remaining may vary. Consider having a replacement available to install when print quality is no longer acceptable. The toner cartridge does not need to be replaced now.


Black Very Low: The product indicates when the toner cartridge level is very low. Actual toner cartridge life remaining may vary. Consider having a replacement available to install when print quality is no longer acceptable. The toner cartridge does not need to be replaced now unless the print quality is no longer acceptable.

Once an HP toner cartridge has reached “very low”, HP’s Premium Protection Warranty on that toner cartridge has ended.

You can change the way the product reacts when supplies reach the Very Low state. You do not have to re-establish these settings when you install a new toner cartridge.

Enable or disable the At Very Low settings

You can enable or disable the default settings at any time, and you do not have to re-enable them when you install a new toner cartridge.

1. From the Home screen on the product control panel, touch the Setup  button.
2. Open the following menus:
 - [System Setup](#)
 - [Supply Settings](#)
 - [Black Cartridge](#)
 - [Very Low Setting](#)
3. Select one of the following options:
 - Select the [Continue](#) option to set the product to alert you that the toner cartridge is very low, but to continue printing.
 - Select the [Stop](#) option to set the product to stop printing (including printing faxes) until you replace the toner cartridge.
 - Select the [Prompt](#) option to set the product to stop printing (including printing faxes) and prompt you to replace the toner cartridge. You can acknowledge the prompt and continue printing. A customer configurable option on this product is "Prompt to Remind Me in 100 pages, 200 pages, 300 pages, 400 pages, or never." This option is provided as a customer convenience and is not an indication these pages will have acceptable print quality.

When the product is set to the [Stop](#) option, there is some risk that faxes will not print after the new cartridge is installed if your product has received more faxes than the memory can hold while stopped.

When the product is set to the [Prompt](#) option, there is some risk that faxes will not print after the new cartridge is installed if your product has received more faxes than the memory can hold while the product is waiting for the prompt to be acknowledged.

Once an HP toner cartridge has reached **Very Low**, HP’s Premium Protection Warranty on that toner cartridge has ended. All print defects or cartridge failures incurred when an HP toner cartridge is used in [Continue](#) at

very low mode will not be considered to be defects in materials or workmanship in the toner cartridge under the HP Print Cartridge Warranty Statement.


Store and recycle supplies

Recycle supplies

To recycle a genuine HP toner cartridge, place the used cartridge in the box in which the new cartridge arrived. Use the enclosed return label to send the used supply to HP for recycling. For complete information, see the recycling guide that is included with each new HP supply item.

Toner cartridge storage

Do not remove the toner cartridge from its package until you are ready to use it.

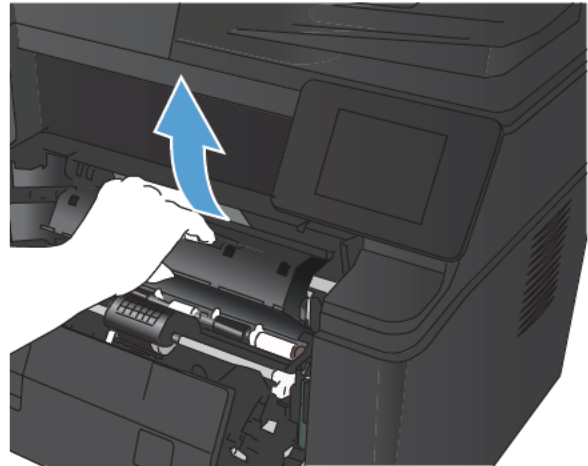
 **CAUTION:** To prevent damage to the toner cartridge, do not expose it to light for more than a few minutes.

Replacement instructions

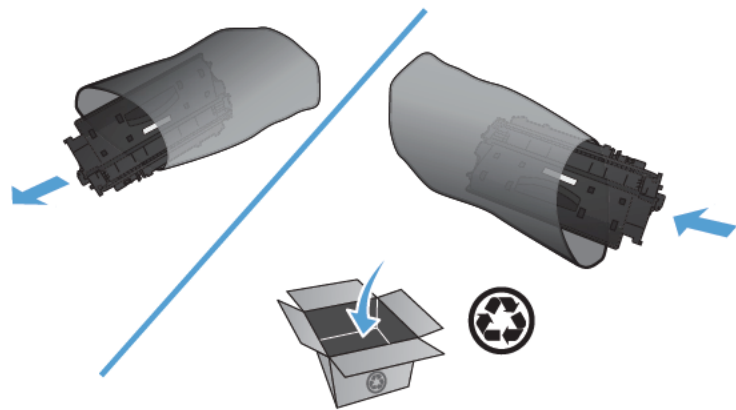
Change the toner cartridge

When a toner cartridge approaches the end of useful life, you are prompted to order a replacement. You can continue printing with the current cartridge until redistributing the toner no longer yields acceptable print quality.

1. Open the toner cartridge door, and then remove the toner cartridge.

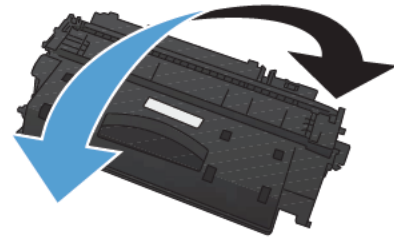


2. Remove the new toner cartridge from the bag. Place the used toner cartridge in the bag for recycling.

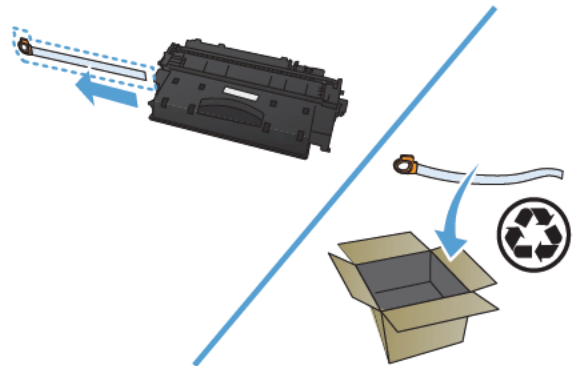


3. Grasp both sides of the toner cartridge and distribute the toner by gently rocking the cartridge.

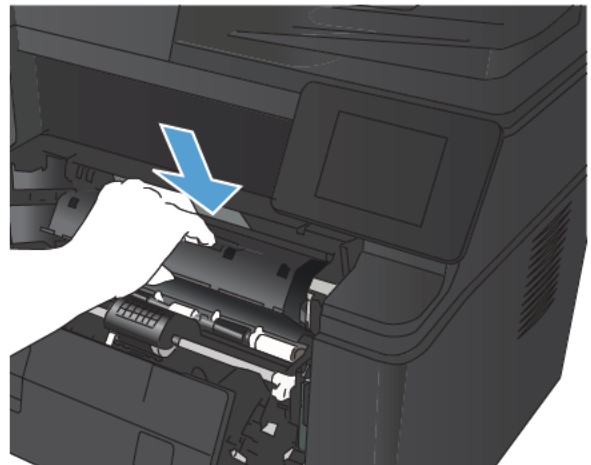
CAUTION: Do not touch the shutter or the surface of the roller.



4. Bend the tab on the left side of the cartridge until the tab breaks loose. Pull the tab until all the tape is removed from the cartridge. Place the tab and tape in the toner cartridge box to return for recycling.



5. Align the toner cartridge with the tracks inside the product, insert the toner cartridge until it is firmly seated, and then close the toner cartridge door.




6. Installation is complete. Place the used toner cartridge in the box in which the new cartridge arrived. See the enclosed recycling guide for recycling instructions.

Memory

This product includes a memory panel that will accept the following third-party font and barcode memory modules. Hewlett-Packard does not sell these products.


- BarDIMM Pro, Jetmobile
- MicrDIMM Pro, Jetmobile
- TypeHaus Fonts and Barcodes Solutions, TypeHaus, Inc.
- Asian Fonts, JITCO, Ltd.
- BarDIMM® Box, Jetmobile
- BarSIMM 1.9, Jetmobile
- EIO Hard-Disk for LaserJet Series, Oberon Service SRL
- Ethernet to Token Ring Router (ETRR), Ringdale
- EuroForm Barcode 100, EuroForm A/S

 **CAUTION:** Handling a memory module without wearing a grounded, antistatic device might damage the module. Touch any metal part of the product or other grounded metal before touching the memory module.


Update the firmware

HP offers periodic upgrades to the product firmware. You can load the firmware updates manually, or you can set the product to automatically load firmware updates.

Manually update the firmware

1. From the Home screen on the product control panel, touch the Setup  button.
2. Open the following menus:
 - [Service](#)
 - [LaserJet Update](#)
 - [Check For Updates Now](#)
3. Touch the [Yes](#) button to prompt the product to search for firmware updates. If the product detects an upgrade, it will begin the update process.

Set the product to automatically update the firmware

1. From the Home screen on the product control panel, touch the Setup  button.
2. Open the following menus:
 - [Service](#)
 - [LaserJet Update](#)
 - [Manage Updates](#)
 - [Prompt Before Install](#)
3. Touch the [Install Automatically](#) option.

8 Solve problems

- [Solve problems checklist](#)
- [Restore the factory-set defaults](#)
- [Control panel help system](#)
- [Interpret control panel messages](#)
- [Paper feeds incorrectly or becomes jammed](#)
- [Clear jams](#)
- [Improve print quality](#)
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- [Solve scan to email problems](#)
- [Solve scan to network folder problems](#)
- [Solve fax quality problems](#)
- [The product does not print or it prints slowly](#)
- [Solve walk-up USB printing problems](#)
- [Solve direct connection problems](#)
- [Solve wired network problems](#)
- [Solve wireless network problems](#)
- [Solve product software problems with Windows](#)
- [Solve product software problems with Mac OS X](#)
- [Remove software \(Windows\)](#)
- [Remove software \(Mac OS X\)](#)

Solve problems checklist

Follow these steps when trying to solve a problem with the product.

- [Step 1: Make sure that the product is set up correctly](#)
- [Step 2: Check the cabling or wireless connection](#)
- [Step 3: Check the control panel for error messages](#)
- [Step 4: Check the paper](#)
- [Step 5: Check the software](#)
- [Step 6: Test print functionality](#)
- [Step 7: Test copy functionality](#)
- [Step 8: Check the toner cartridge](#)
- [Step 9: Try sending a print job from a computer](#)
- [Step 10: Verify that the product is on the network](#)

Step 1: Make sure that the product is set up correctly

1. Press the power button to turn on the product or to deactivate the Auto Power Down mode.
2. Check the power-cable connections.
3. Make sure that the line voltage is correct for the product power configuration. (See the label on the back of the product for voltage requirements.) If you are using a power strip and its voltage is not within specifications, plug the product directly into the wall. If it is already plugged into the wall, try a different outlet.
4. If none of these measures restores power, contact HP Customer Care.

Step 2: Check the cabling or wireless connection

1. Check the cable connection between the product and the computer. Make sure that the connection is secure.
2. Make sure that the cable itself is not faulty by using a different cable, if possible.
3. If the product is connected to a network, check the following items:
 - Check the light next to the network connection on the product. If the network is active, the light is green.
 - Make sure that you are using a network cable and not a phone cord to connect to the network.
 - Make sure the network router, hub, or switch is turned on and that it is working correctly.
 - If your computer or the product is connected to a wireless network, low signal quality or interference might be delaying print jobs.
4. If you are using a personal firewall system on the computer, it might be blocking communication with the product. Try temporarily disabling the firewall to see if it is the source of the problem.

Step 3: Check the control panel for error messages

The control panel should indicate ready status. If an error message appears, resolve the error.

Step 4: Check the paper

1. Make sure that the paper that you are using meets specifications.
2. Make sure that the paper is loaded correctly in the input tray.

Step 5: Check the software


1. Make sure that the product software is installed correctly.
2. Verify that you have installed the print driver for this product. Check the program to make sure that you are using the print driver for this product.

Step 6: Test print functionality

1. Print a configuration page.
2. If the page does not print, verify that the input tray contains paper.
3. If the page jams in the product, clear the jam.

Step 7: Test copy functionality

1. Place the configuration page onto the capture stage and make a copy.
2. If the print quality on the copied pages is not acceptable, clean the cover over the camera lens with a soft cloth or sponge that has been moistened with nonabrasive glass cleaner.

 **CAUTION:** Do not use abrasives, acetone, benzene, ammonia, ethyl alcohol, or carbon tetrachloride on any part of the product; these can damage the product. Do not place liquids directly on the capture stage. They might seep and damage the product.

Step 8: Check the toner cartridge

Print a supplies status page and check remaining life of the toner cartridge.

Step 9: Try sending a print job from a computer

1. Try printing the job from another computer that has the product software installed.
2. Check the USB or network cable connection. Direct the product to the correct port, or reinstall the software, selecting the connection type that you are using.
3. If the print quality is unacceptable, verify that the print settings are correct for the media that you are using.


Step 10: Verify that the product is on the network

For networked products, open a Web browser, type the product IP address (from the previously printed configuration page) in the address box, and then press the [Enter](#) button to open the HP Embedded Web Server. If the HP EWS does not open, reinstall the product on the network.

Restore the factory-set defaults

Restoring the factory-set defaults returns all of the product and network settings to the factory defaults. It will not reset the page count, tray size, or language. To restore the product to the factory-default settings, follow these steps.

⚠ CAUTION: Restoring the factory-set defaults returns all of the settings to the factory defaults, and it also deletes any pages that are stored in the memory. The procedure then automatically restarts the product.

1. On the product control panel, touch the Setup  button.
2. Scroll to and touch the [Service](#) menu.
3. Scroll to and touch the [Restore Defaults](#) button, and then touch the [OK](#) button.

The product automatically restarts.

Control panel help system

The product has a built-in Help system that explains how to use each screen. To open the Help system, touch the Help ? button in the upper-right corner of the screen.

For some screens, the Help opens to a global menu where you can search for specific topics. You can browse through the menu structure by touching the buttons in the menu.

Some Help screens include animations that guide you through procedures, such as clearing jams.

For screens that contain settings for individual jobs, the Help opens to a topic that explains the options for that screen.

If the product alerts you of an error or warning, touch the Help ? button to open a message that describes the problem. The message also contains instructions to help solve the problem.

Interpret control panel messages

Control panel message types

The control panel messages indicate the current product status or situations that might require action.

Alert and warning messages appear temporarily and might require you to acknowledge the message by pressing the **OK** button to resume or by pressing the Cancel **X** button to cancel the job. With certain warnings, the job might not complete or the print quality might be affected. If the alert or warning message is related to printing and the auto-continue feature is on, the product will attempt to resume the printing job after the warning has appeared for 10 seconds without acknowledgement.

Critical error messages can indicate some kind of failure. Turning off and then turning on the power might fix the problem. If a critical error persists, the product might require service.

Control panel messages

49 Error, Turn off then on

Description

The product experienced an internal error.

Recommended action

Turn the product off, wait at least 30 seconds, and then turn the product on and wait for it to initialize.

If you are using a surge protector, remove it. Plug the product directly into the wall socket. Turn the product power on.

If the message persists, contact HP support.

50.x Fuser Error

Description

The product has experienced an error with the fuser.

Recommended action

Turn the product power off, wait at least 30 seconds, and then turn the product power on and wait for it to initialize.

Turn off the product, wait at least 25 minutes, and then turn on the product.

If you are using a surge protector, remove it. Plug the product directly into the wall socket. Turn the product power on.

If the message persists, contact HP support.

51.XX Error

Description

The product has experienced an internal hardware error.

Recommended action

Turn the product power off, wait at least 30 seconds, and then turn the product power on and wait for it to initialize.

If you are using a surge protector, remove it. Plug the product directly into the wall socket. Turn the product on.

If the message persists, contact HP support.

54.XX Error

Description

The product has experienced an error with one of the internal sensors.

Recommended action

Turn the product power off, wait at least 30 seconds, and then turn the product power on and wait for it to initialize.

If you are using a surge protector, remove it. Plug the product directly into the wall socket. Turn the product power on.

If the message persists, contact HP support.

55.X Error

Description

The product has experienced an internal error.

Recommended action

Turn the product power off, wait at least 30 seconds, and then turn the product power on and wait for it to initialize.

If you are using a surge protector, remove it. Plug the product directly into the wall socket. Turn the product power on.

If the message persists, contact HP support.

57 Fan Error, Turn off then on

Description

The product has experienced a problem with its internal fan.

Recommended action

Turn the product power off, wait at least 30 seconds, and then turn the product power on and wait for it to initialize.

If you are using a surge protector, remove it. Plug the product directly into the wall socket. Turn the product power on.

If the message persists, contact HP support.

59.X Error

Description

The product has experienced a problem with one of the motors.

Recommended action

Turn the product power off, wait at least 30 seconds, and then turn the product power on and wait for it to initialize.

If you are using a surge protector, remove it. Plug the product directly into the wall socket. Turn the product power on.

If the message persists, contact HP support.

79 Error Turn off then on

Description

The product has experienced an internal firmware error.

Recommended action

Turn the product power off, wait at least 30 seconds, and then turn the product power on and wait for it to initialize.

If you are using a surge protector, remove it. Plug the product directly into the wall socket. Turn the product power on.

If the message persists, contact HP support.

79 Service error

Description

An incompatible DIMM is installed.

Recommended action

1. Turn the product power off.
2. Install a DIMM that the product supports.
3. Turn the product on.

If the message persists, contact HP support.

Black cartridge low

Description

The toner cartridge is nearing the end of its useful life.

Recommended action

Printing can continue, but consider having a replacement toner cartridge on hand.

Black cartridge very low

Description

The toner cartridge is at the end of its useful life. A customer configurable option on this product is "Prompt to Remind Me in 100 pages, 200 pages, 300 pages, 400 pages, or never." This option is provided as a customer convenience and is not an indication these pages will have acceptable print quality.

Recommended action

To ensure optimal print quality, HP recommends replacing the toner cartridge at this point. You can continue printing until you notice a decrease in print quality. Actual cartridge life may vary.

Once an HP toner cartridge has reached very low, HP's Premium Protection Warranty on that toner cartridge has ended. All print defects or cartridge failures incurred when an HP toner cartridge is used in continue at very low mode will not be considered to be defects in materials or workmanship in the toner cartridge under the HP Print Cartridge Warranty Statement.

Cleaning

Description

The product periodically performs a cleaning procedure to maintain the best print quality.

Recommended action

Wait for the cleaning process to finish.

Device error, press OK

Description

An internal error occurred.

Recommended action

Press the **OK** button to resume the job.

Door open

Description

The product front door is open.

Recommended action

Close the door.

Genuine HP supply installed

Description

A genuine HP toner cartridge was installed.

Recommended action

No action necessary.

Incompatible black

Description

You have installed a toner cartridge that is intended for use in a different HP product model. The product might not function correctly with this toner cartridge installed.

Recommended action

Install the correct toner cartridge for this product.

Install black cartridge

Description

The toner cartridge is either not installed or not correctly installed in the product.

Recommended action

Install the toner cartridge.

Invalid driver Press [OK]

Description

You are using an incorrect print driver.

Recommended action

Select the correct print driver.

Jam in Tray 1, Clear jam and then press OK

Description

The product has detected a jam.

Recommended action

Clear the jam from the tray, and then press **OK**.

If the message persists, contact HP support.

Load Tray 1 <TYPE> <SIZE>, Press OK to use available media

Description

The tray is not configured for the paper type and size that the print job is requesting.

Recommended action

Load the correct paper into Tray 1. Or press the **OK** button to use the paper currently in the tray.

Load Tray 1, <PLAIN> <SIZE> / Cleaning mode, OK to start

Description

The product is ready to process the cleaning operation.

Recommended action

Load Tray 1 with plain paper in the size indicated, and then press the **OK** button.

Load tray <X> Press [OK] for available media

Description

The tray is empty.

Recommended action

Load paper into the tray to continue printing. Press the **OK** button to select a different tray.

Load tray <X> <TYPE> <SIZE>

Description

A tray is configured for the paper type and size that the print job is requesting, but that tray is empty.

Recommended action

Load the correct paper into the tray, or press the **OK** button to use paper in a different tray.

Manual Duplex Load Tray 1, Press OK

Description

The first side of a manual duplex job has printed, and the page needs to be loaded to process the second side.

Recommended action

Load the page in the indicated tray with the side to be printed face up, and the top of the page away from you and then press the **OK** button.

Manual feed <SIZE> <TYPE>, Press OK to use available media

Description

The product is set for manual feed mode.

Recommended action

Press the **OK** button to clear the message or load the correct paper into Tray 1.

Memory is low. Press OK.

Description

The product memory is almost full.

Recommended action

Press the **OK** button to finish the job, or press the Cancel **X** button to cancel the job.

Break the job into smaller jobs that contain fewer pages.

Misprint, Press OK

Description

Paper has been delayed as it moves through the product.

Recommended action

Press the **OK** button to clear the message.

To avoid this problem, try the following solutions:

1. Adjust the paper guides in the tray. Make sure the front paper guide is pushing the paper against the back edge of the tray.
2. Use paper that meets HP specifications. Store paper unopened in its original packaging.
3. Use the product in an area that meets the environmental specifications for this product.

Print failure, press OK. If error repeats, turn off then on.

Description

The product cannot process the page.

Recommended action

Press the **OK** button to continue printing the job, but output might be affected.

If the error persists, turn the power off and then on. Resend the print job.

Rear door open

Description

The product rear door is open.

Recommended action

Close the door.

Remove shipping material from toner cartridge

Description

A toner cartridge shipping lock is installed.

Recommended action

Pull the orange tab to remove the shipping lock from the cartridge.

Replace black cartridge

Description

The toner cartridge is at the end of its useful life, and the product is customer-configured to stop printing when it reaches the very low state.

Recommended action

To ensure optimal print quality, HP recommends replacing the toner cartridge at this point. You can continue printing until you notice a decrease in print quality. Actual cartridge life may vary. Once an HP toner cartridge has reached very low, HP's Premium Protection Warranty on that toner cartridge has ended. All print defects or cartridge failures incurred when an HP toner cartridge is used in Continue at Very Low mode will not be considered to be defects in materials or workmanship in the toner cartridge under the HP Print Cartridge Warranty Statement.

Unexpected size in tray <X> Load <size> Press [OK]**Description**

The product has detected paper in the tray that does not match the configuration for the tray.

Recommended action

Load the correct paper into the tray, or configure the tray for the size that you have loaded.

Unsupported black cartridge Press [OK] to continue**Description**

The product has detected an installed toner cartridge that was not made by HP.

Recommended action

Press the **OK** button to continue printing.

If you believe you purchased an HP supply, go to www.hp.com/go/anticounterfeit. Service or repairs that are required as a result of using unsupported supplies are not covered under HP warranty.

Used black cartridge is installed Press [OK] to continue**Description**

You are using a toner cartridge that reached the default low threshold while it was installed in a product.

Recommended action

Printing can continue, but consider having a replacement toner cartridge on hand.

Paper feeds incorrectly or becomes jammed

The product does not pick up paper

If the product does not pick up paper from the tray, try these solutions.

1. Open the product and remove any jammed sheets of paper.
2. Load the tray with the correct size of paper for your job.
3. Make sure the paper guides in the tray are adjusted correctly for the size of paper. Adjust the guides so they are touching the paper stack without bending it.
4. Check the product control panel to see if the product is waiting for you to acknowledge a prompt to feed the paper manually. Load paper, and continue.

The product picks up multiple sheets of paper

If the product picks up multiple sheets of paper from the tray, try these solutions.

1. Remove the stack of paper from the tray and flex it, rotate it 180 degrees, and flip it over. *Do not fan the paper.* Return the stack of paper to the tray.
2. Use only paper that meets HP specifications for this product.
3. Use paper that is not wrinkled, folded, or damaged. If necessary, use paper from a different package.
4. Make sure the tray is not overfilled. If it is, remove the entire stack of paper from the tray, straighten the stack, and then return some of the paper to the tray.
5. Make sure the paper guides in the tray are adjusted correctly for the size of paper. Adjust the guides so they are touching the paper stack without bending it.

Prevent paper jams

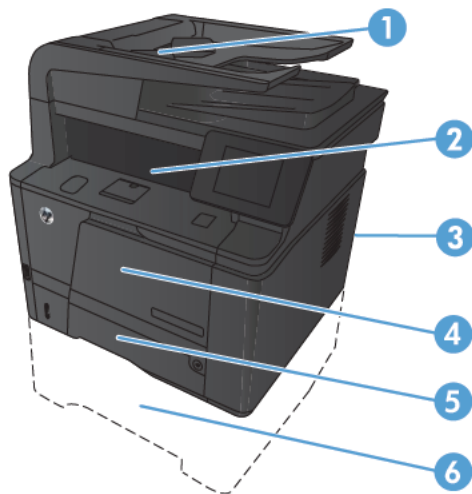
To reduce the number of paper jams, try these solutions.

1. Use only paper that meets HP specifications for this product.
2. Use paper that is not wrinkled, folded, or damaged. If necessary, use paper from a different package.
3. Use paper that has not previously been printed or copied on.
4. Make sure the tray is not overfilled. If it is, remove the entire stack of paper from the tray, straighten the stack, and then return some of the paper to the tray.
5. Make sure the paper guides in the tray are adjusted correctly for the size of paper. Adjust the guides so they are touching the paper stack without bending it.
6. If you are printing on heavy, embossed, or perforated paper, use the manual feed feature and feed sheets one at a time.

Clear jams

Jam locations

Jams can occur in these locations:

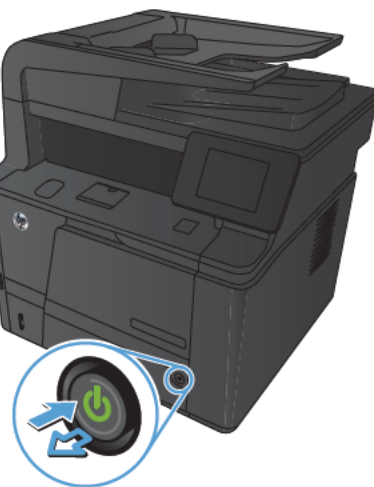


1	Document feeder
2	Output bin
3	Rear door
4	Tray 1
5	Tray 2
6	Optional Tray 3

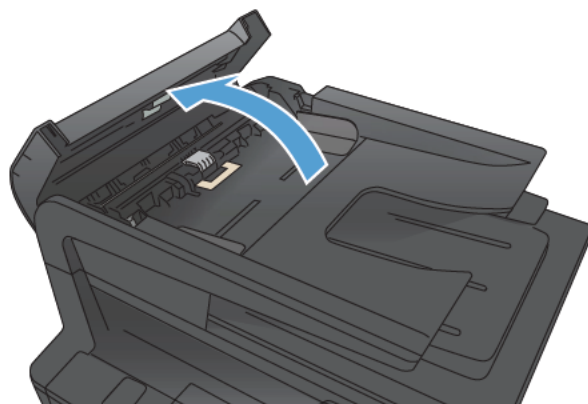
Loose toner might remain in the product after a jam. This problem typically resolves itself after a few sheets have been printed.

Clear jams from the document feeder

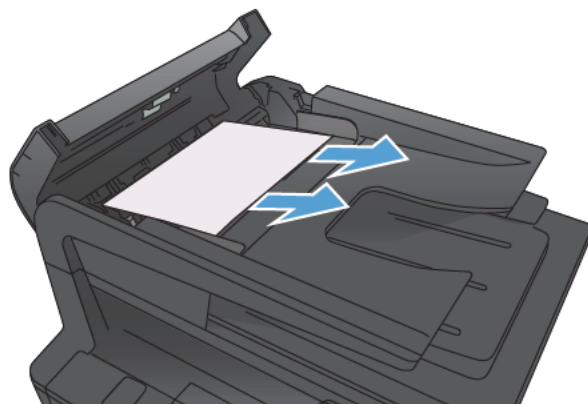
1. Turn the product off.



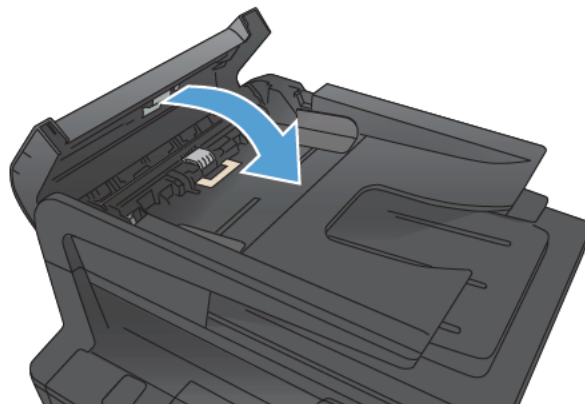
2. Open the document feeder cover.



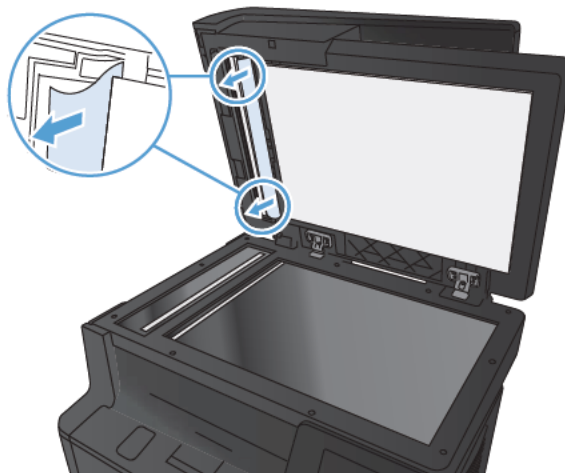
3. Gently pull the jammed paper out.



4. Close the document feeder roller assembly, and then close the document feeder cover.



5. Open the scanner lid. If paper is jammed in the scanner lid, gently pull it out.

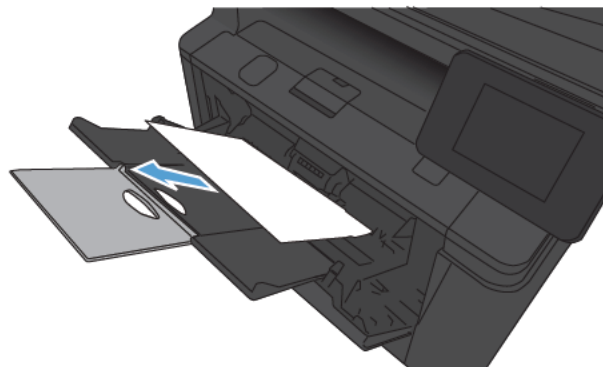


Clear a jam in Tray 1

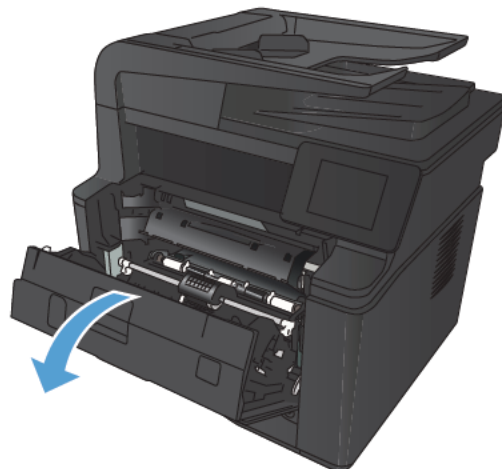


NOTE: If the sheet tears, remove all fragments before resuming printing.

1. If you can see the jammed sheet, remove the jammed sheet by pulling it straight out.



2. If you cannot see the jammed sheet, open the print cartridge door, and then remove the print cartridge.

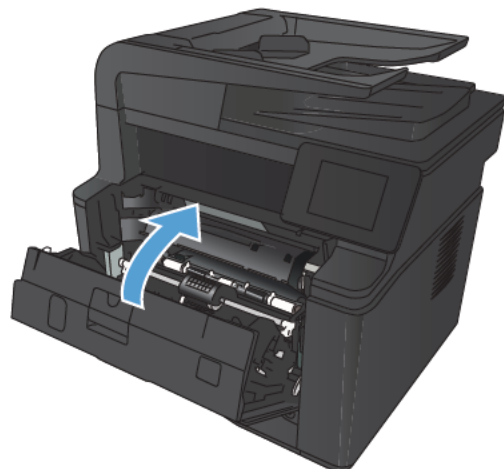


3. Remove the jammed sheet by pulling it straight out.

CAUTION: Do not pull up on the jammed sheet. Be sure to pull it straight out.

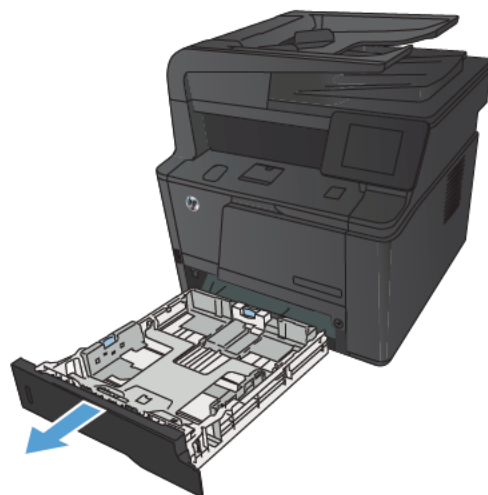


4. Reinstall the print cartridge, and then close the print cartridge door.

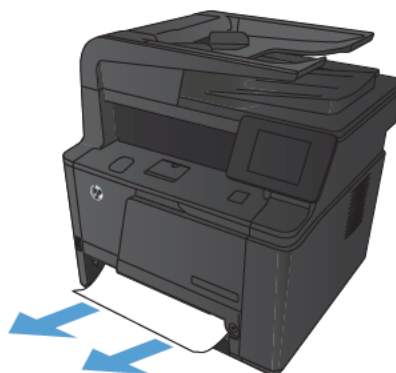


Clear a jam in Tray 2

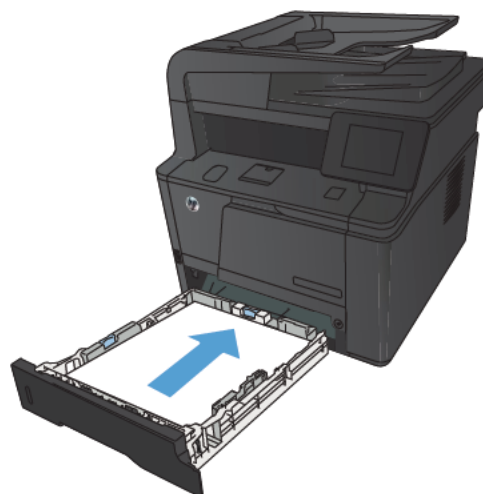
1. Remove the tray from the product.



2. Remove the jammed sheet by pulling it straight out.



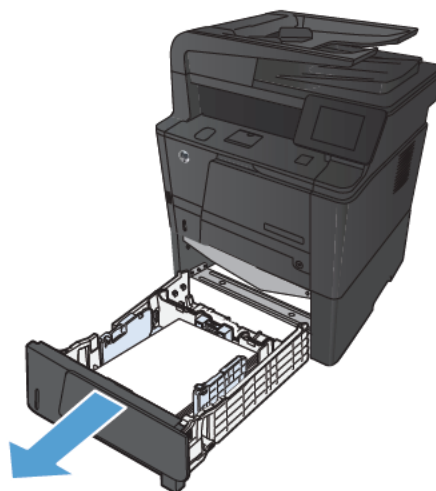
3. Replace the tray.



4. Press the **OK** button to continue printing.

Clear a jam in optional Tray 3

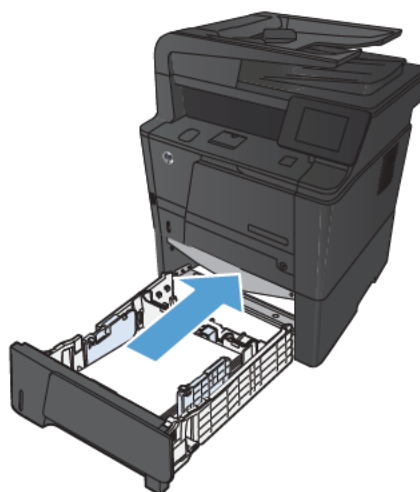
1. Remove the tray from the product.



2. Remove the jammed sheet by pulling it straight out.



3. Replace the tray.

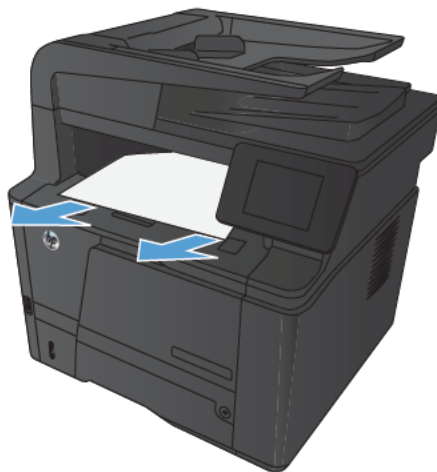


4. Press the **OK** button to continue printing.

Clear jams from the output bin

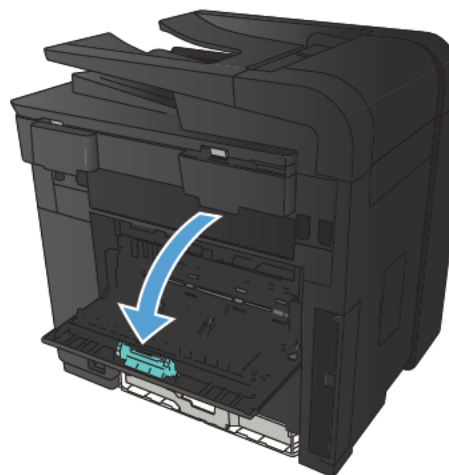
⚠ CAUTION: Do not use sharp objects, such as tweezers or needle-nose pliers, to remove jams. Damage caused by sharp objects will not be covered by the warranty.

1. With both hands, grasp the paper, and carefully pull it free from the product.



Clear a jam in the duplexer area

1. Open the rear door.



2. Remove any jammed sheets.

NOTE: If the sheet tears, remove all fragments before resuming printing.

CAUTION: Wait until the fuser area has cooled before clearing the jam.

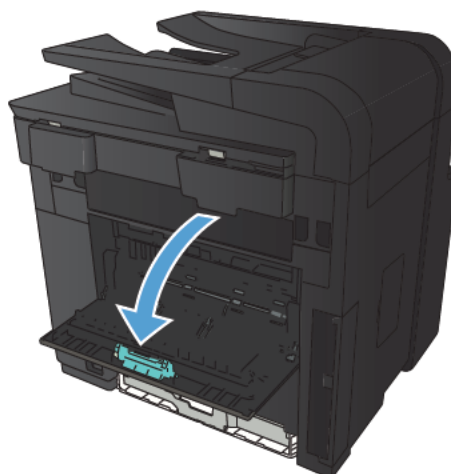


3. Close the rear door.



Clear a jam in the fuser area

1. Open the rear door.



2. Remove any jammed sheets.

NOTE: If the sheet tears, remove all fragments before resuming printing.

CAUTION: Wait until the fuser area has cooled before clearing the jam.



3. Close the rear door.



Improve print quality

Check the paper type setting (Windows)

Check the paper type setting if you are having any of the following problems:

- Toner is smearing on the printed pages.
 - Repeated marks occur on the printed pages.
 - Printed pages are curled.
 - Toner flakes off the printed pages.
 - Printed pages have small unprinted areas.
1. From the software program, select the **Print** option.
 2. Select the product, and then click the **Properties** or **Preferences** button.
 3. Click the **Paper/Quality** tab.
 4. From the **Paper type** drop-down list, click the **More...** option.
 5. Expand the list of **Type is:** options.
 6. Expand each category of paper types until you find the paper type that you are using.
 7. Select the option for the type of paper you are using, and then click the **OK** button.

Check the paper type setting (Mac OS X)

Check the paper type setting if you are having any of the following problems:

- Toner is smearing on the printed pages.
 - Repeated marks occur on the printed pages.
 - Printed pages are curled.
 - Toner flakes off the printed pages.
 - Printed pages have small unprinted areas.
1. On the **File** menu, click the **Print** option.
 2. In the **Printer** menu, select this product.
 3. In the **Copies & Pages** menu, click the **Page Setup** button.
 4. Select a size from the **Paper Size** drop-down list, and then click the **OK** button.
 5. Open the **Finishing** menu.
 6. Select a type from the **Media-type** drop-down list.
 7. Click the **Print** button.


Check toner cartridge status

Print the supplies status page

Information pages reside within the product memory. These pages help diagnose and solve problems with the product.



NOTE: If the product language was not correctly set during installation, you can set the language manually so the information pages print in one of the supported languages. Change the language by using the [System Setup](#) menu on the control panel or the embedded Web server.


1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the [Reports](#) button.
3. Touch the [Supplies Status](#) button to print the report.

Check the supplies status

Check the supplies status page for the following information:

- Estimated percentage of cartridge life remaining
- Approximate pages remaining
- Part numbers for HP toner cartridges
- Number of pages printed

Print a cleaning page

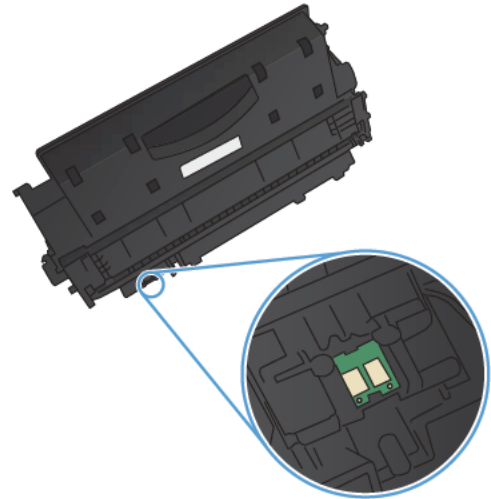
1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the [Service](#) menu.
3. Touch the [Cleaning Page](#) button.
4. Load plain letter or A4 paper when you are prompted.
5. Touch the [OK](#) button to begin the cleaning process.

The product prints the first side and then prompts you to remove the page from the output bin and reload it in Tray 1, keeping the same orientation. Wait until the process is complete. Discard the page that prints.

Inspect the toner cartridge for damage

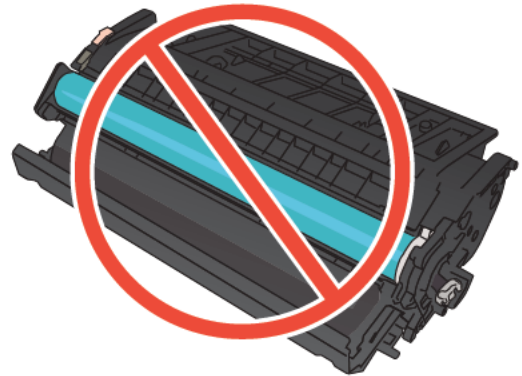
1. Remove the toner cartridge from the product, and verify that the sealing tape has been removed.

2. Check the memory chip for damage.



3. Examine the surface of the imaging drum on the bottom of the toner cartridge.

CAUTION: Do not touch the roller (imaging drum) on the bottom of the cartridge. Fingerprints on the imaging drum can cause print-quality problems.



4. If you see any scratches, fingerprints, or other damage on the imaging drum, replace the toner cartridge.
5. If the imaging drum does not appear to be damaged, rock the toner cartridge gently several times and reinstall it. Print a few pages to see if the problem has resolved.

Check the paper and printing environment

Use paper that meets HP specifications

Use different paper if you are having any of the following problems:

- The printing is too light or seems faded in areas.
- Specks of toner are on the printed pages.
- Toner is smearing on the printed pages.
- Printed characters seem misformed.
- Printed pages are curled.

Always use a paper type and weight that this product supports. In addition, follow these guidelines when selecting paper:

- Use paper that is of good quality and free of cuts, nicks, tears, spots, loose particles, dust, wrinkles, voids, staples, and curled or bent edges.
- Use paper that has not been previously printed on.
- Use paper that is designed for use in laser printers. Do not use paper that is designed only for use in inkjet printers.
- Use paper that is not too rough. Using smoother paper generally results in better print quality.

Check the product environment

Verify that the product is operating within the environmental specifications listed in the product Warranty and Legal Guide.

Check print job settings

Check the EconoMode setting

This product has an EconoMode option for printing drafts of documents. Using EconoMode can use less toner. However, using EconoMode can also reduce print quality. To improve print quality, verify that the EconoMode setting is deactivated.

1. From the software program, select the **Print** option.
2. Select the product, and then click the **Properties** or **Preferences** button.
3. Click the **Paper/Quality** tab.
4. Verify that the **EconoMode** check box is cleared. If there is a checkmark in the check box, click the check box to clear it.

HP does not recommend the full-time use of EconoMode. If EconoMode is used full-time, the toner supply might outlast the mechanical parts in the toner cartridge. If print quality begins to degrade and is no longer acceptable, consider replacing the toner cartridge.

Use the print driver that best meets your printing needs

You might need to use a different print driver if the printed page has unexpected lines in graphics, missing text, missing graphics, incorrect formatting, or substituted fonts.

HP PCL 6 driver	<ul style="list-style-type: none">• Provided as the default driver. This driver is automatically installed unless you select a different one.• Recommended for all Windows environments• Provides the overall best speed, print quality, and product-feature support for most users• Developed to align with the Windows Graphic Device Interface (GDI) for the best speed in Windows environments• Might not be fully compatible with third-party and custom software programs that are based on PCL 5
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HP UPD PS driver	<ul style="list-style-type: none">• Recommended for printing with Adobe® software programs or with other highly graphics-intensive software programs• Provides support for printing from postscript emulation needs, or for postscript flash font support
HP UPD PCL 5	<ul style="list-style-type: none">• Recommended for general office printing in Windows environments• Compatible with previous PCL versions and older HP LaserJet products• The best choice for printing from third-party or custom software programs• The best choice when operating with mixed environments, which require the product to be set to PCL 5 (UNIX, Linux, mainframe)• Designed for use in corporate Windows environments to provide a single driver for use with multiple printer models• Preferred when printing to multiple printer models from a mobile Windows computer
HP UPD PCL 6	<ul style="list-style-type: none">• Recommended for printing in all Windows environments• Provides the overall best speed, print quality, and printer feature support for most users• Developed to align with Windows Graphic Device Interface (GDI) for best speed in Windows environments• May not be fully compatible with third-party and custom solutions based on PCL5

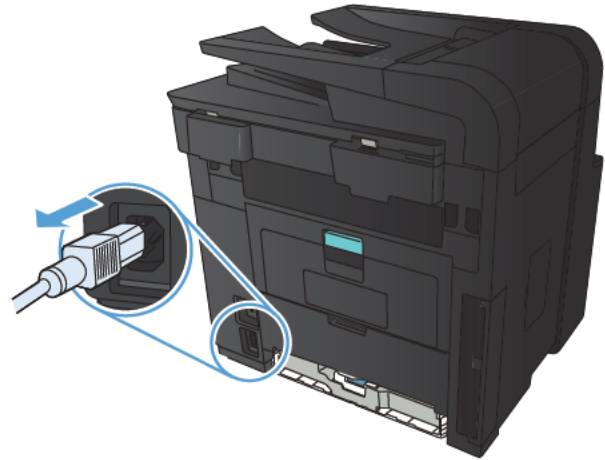
Download additional print drivers from this Web site: www.hp.com/support/ljm425series.

Solve copy quality problems

Check the scanner glass for dirt and smudges

Over time, specks of debris might collect on the scanner glass and white plastic backing, which can affect performance. Use the following procedure to clean the scanner.

1. Use the power switch to turn off the product, and then unplug the power cord from the electrical socket.



2. Open the scanner lid.
3. Clean the scanner glass, the document feeder strips, and the white plastic backing with a soft cloth or sponge that has been moistened with nonabrasive glass cleaner.

CAUTION: Do not use abrasives, acetone, benzene, ammonia, ethyl alcohol, or carbon tetrachloride on any part of the product; these can damage the product. Do not place liquids directly on the glass or platen. They might seep and damage the product.



4. Dry the glass and white plastic parts with a chamois or a cellulose sponge to prevent spotting.
5. Plug in the product, and then use the power switch to turn on the product.

Check the paper settings

1. From the Home screen on the product control panel, touch the **Copy** button.



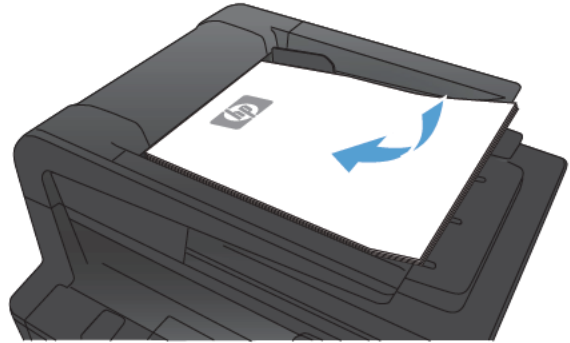
2. Touch the **Settings** button, and then scroll to and touch the **Paper** button.
3. From the list of paper sizes, touch the name of the paper size that is in Tray 1.
4. From the list of paper types, touch the name of the paper type that is in Tray 1.
5. Touch the **Black** or **Color** button to start copying.

Optimize for text or pictures

The following copy-quality settings are available:

- **Auto Select:** Use this setting when you are not concerned about the quality of the copy. This is the default setting.
- **Mixed:** Use this setting for documents that contain a mixture of text and graphics.
- **Text:** Use this setting for documents that contain mostly text.
- **Picture:** Use this setting for documents that contain mostly graphics.

1. Load the document onto the scanner glass or into the document feeder.



2. From the Home screen on the product control panel, touch the **Copy** button.
3. Touch the **Settings** button, and then scroll to and touch the **Optimize** button. Touch the arrow buttons to scroll through the options, and then touch an option to select it.
4. Touch the **Start Copy** button to start copying.

Edge-to-edge copying

The product cannot print fully edge-to-edge. The maximum printing area is 203.2 x 347 mm (8 x 13.7 in), leaving a 4 mm unprintable border around the page.

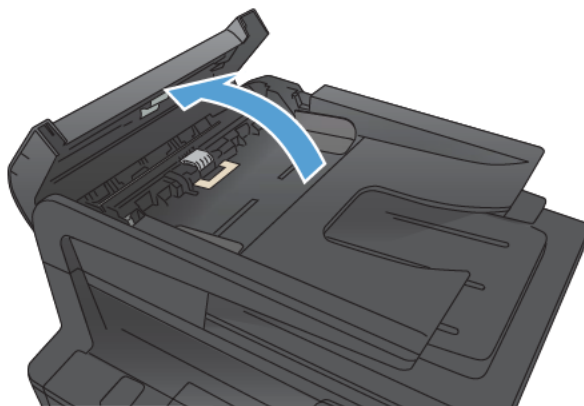
Considerations for printing or scanning documents with cropped edges:

- When the original is smaller than the output size, move the original 4 mm (1/6 inch) away from the corner indicated by the icon on the scanner. Recopy or scan in this position.
- When the original is the size of the desired output, use the **Reduce/Enlarge** feature to reduce the image so the copy is not cropped.

Clean the pickup rollers and separation pad in the document feeder

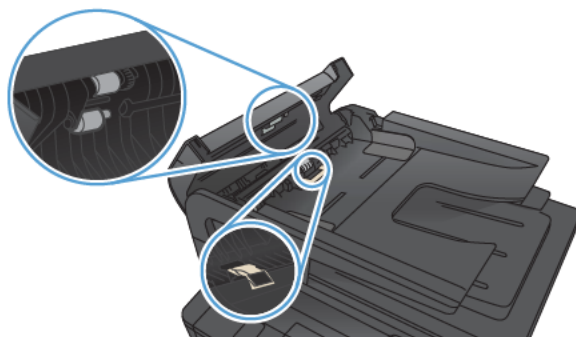
If the product document feeder experiences paper-handling problems, such as jams or multiple-page feeds, clean the document feeder rollers and separation pad.

1. Open the document feeder cover.

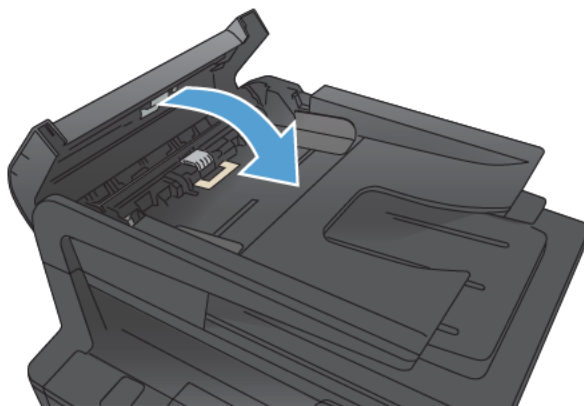


2. Use a moist, lint-free cloth to wipe both pickup rollers and the separation pad to remove dirt.

CAUTION: Do not use abrasives, acetone, benzene, ammonia, ethyl alcohol, or carbon tetrachloride on any part of the product; these can damage the product. Do not place liquids directly on the glass or platen. They might seep and damage the product.



3. Close the document feeder cover.

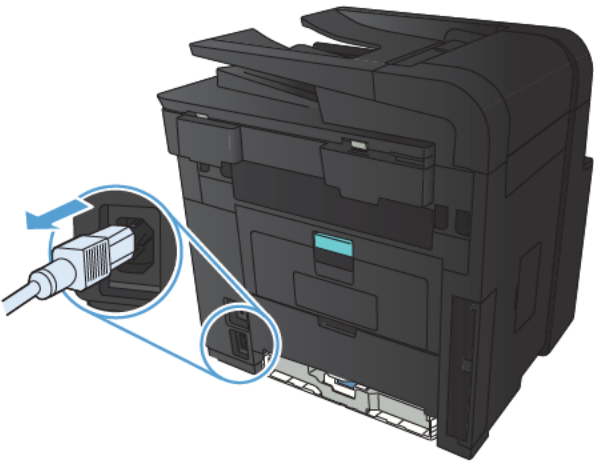


Solve scan quality problems

Check the scanner glass for dirt and smudges

Over time, specks of debris might collect on the scanner glass and white plastic backing, which can affect performance. Use the following procedure to clean the scanner.

- 1. Use the power switch to turn off the product, and then unplug the power cord from the electrical socket.



- 2. Open the scanner lid.
- 3. Clean the scanner glass, the document feeder strips, and the white plastic backing with a soft cloth or sponge that has been moistened with nonabrasive glass cleaner.

CAUTION: Do not use abrasives, acetone, benzene, ammonia, ethyl alcohol, or carbon tetrachloride on any part of the product; these can damage the product. Do not place liquids directly on the glass or platen. They might seep and damage the product.



- 4. Dry the glass and white plastic parts with a chamois or a cellulose sponge to prevent spotting.
- 5. Plug in the product, and then use the power switch to turn on the product.

Check the resolution settings

The following table describes the recommended resolution and color settings for different types of scan jobs.



NOTE: The default resolution is 200 ppi.

Intended use	Recommended resolution	Recommended color settings
Fax	150 ppi	<ul style="list-style-type: none"> Black and white
Email	150 ppi	<ul style="list-style-type: none"> Black and white, if the image does not require smooth gradation Grayscale, if the image requires smooth gradation Color, if the image is in color
Edit text	300 ppi	<ul style="list-style-type: none"> Black and white
Print (graphics or text)	600 ppi for complex graphics, or if you want to significantly enlarge the document 300 ppi for normal graphics and text 150 ppi for photos	<ul style="list-style-type: none"> Black and white for text and line art Grayscale for shaded or colored graphics and photos Color, if the image is in color
Display on screen	75 ppi	<ul style="list-style-type: none"> Black and white for text Grayscale for graphics and photos Color, if the image is in color

Check the color settings

You can set the color values to the following settings when scanning.

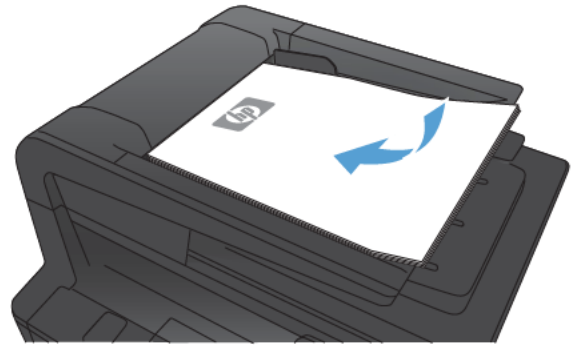
Setting	Recommended use
Color	Use this setting for high-quality color photos or documents in which the color is important.
Black and White	Use this setting for text documents.
Grayscale	Use this setting when file size is an issue or when you want to scan a document or photograph quickly.

Optimize for text or pictures

The following copy-quality settings are available:

- **Auto Select:** Use this setting when you are not concerned about the quality of the copy. This is the default setting.
- **Mixed:** Use this setting for documents that contain a mixture of text and graphics.
- **Text:** Use this setting for documents that contain mostly text.
- **Picture:** Use this setting for documents that contain mostly graphics.

1. Load the document onto the scanner glass or into the document feeder.

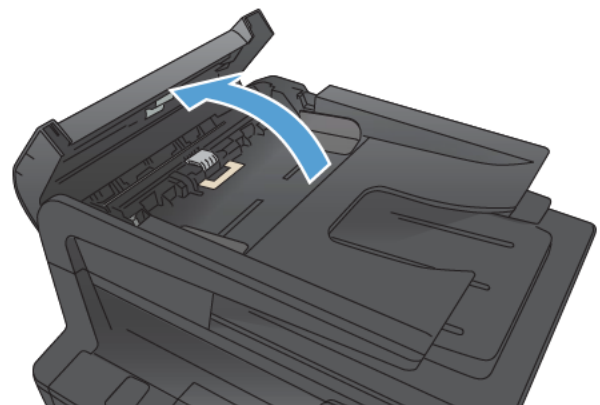


2. From the Home screen on the product control panel, touch the **Copy** button.
3. Touch the **Settings** button, and then scroll to and touch the **Optimize** button. Touch the arrow buttons to scroll through the options, and then touch an option to select it.
4. Touch the **Start Copy** button to start copying.

Clean the pickup rollers and separation pad in the document feeder

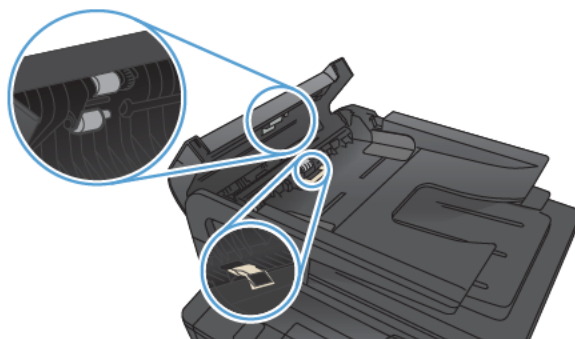
If the product document feeder experiences paper-handling problems, such as jams or multiple-page feeds, clean the document feeder rollers and separation pad.

1. Open the document feeder cover.

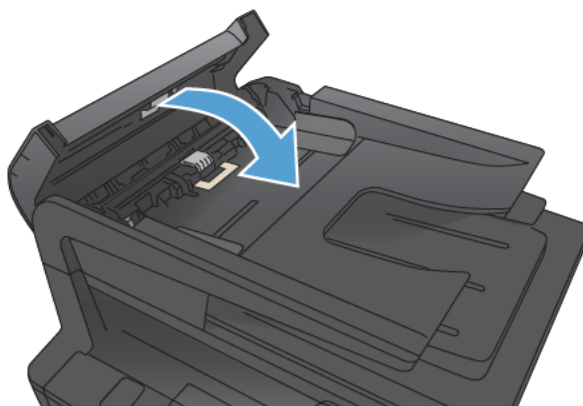


2. Use a moist, lint-free cloth to wipe both pickup rollers and the separation pad to remove dirt.

CAUTION: Do not use abrasives, acetone, benzene, ammonia, ethyl alcohol, or carbon tetrachloride on any part of the product; these can damage the product. Do not place liquids directly on the glass or platen. They might seep and damage the product.



3. Close the document feeder cover.



Solve scan to email problems

If scan to email problems occur, try these solutions:

- Make sure this feature has been set up. If this feature has not been set up, use the setup wizard in the HP Device Toolbox (Windows) or HP Utility for Mac OS X software to set it up.
- Make sure the Scan to Email feature is enabled. If it has been disabled, enable the feature through the HP Device Toolbox (Windows) or HP Utility for Mac OS X software.
- Make sure the product is connected to a computer or to a network.

Cannot connect to the email server

- Make sure the SMTP server name is correct. Check this setting with your system administrator or Internet Service Provider.
- If the product cannot establish a secure connection to the SMTP server, try without the secure connection or try a different server or port. Check this setting with your system administrator or Internet Service Provider.
- If the SMTP server requires authentication, make sure a valid user name and password are used.
- If the SMTP server uses an authentication method that is not supported, try a different server. Check this setting with your system administrator or Internet Service Provider.

The email failed

- Verify that email addresses entered are correct.
- If the size of the email was too large, send fewer pages or reduce the scan resolution.

Unable to scan

- If you are prompted for a PIN, enter the correct PIN for the outgoing profile.
- Make sure at least one email address is selected in the [To](#) field.

Solve scan to network folder problems

If scan to network folder problems occur, try these solutions:

- Make sure this feature has been set up. If this feature has not been set up, use the setup wizard in the HP Device Toolbox (Windows) or HP Utility for Mac OS X software to set it up.
- Make sure the Scan to Network Folder feature is enabled. If it has been disabled, enable the feature through the HP Device Toolbox (Windows) or HP Utility for Mac OS X software.
- Make sure the product is connected to a network.

The scan failed

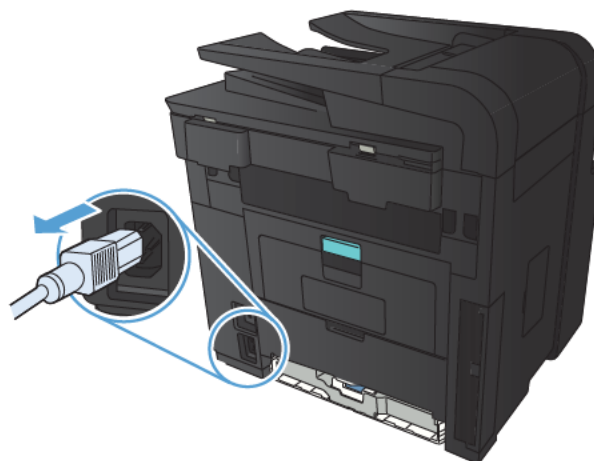
- Make sure the network path is in the correct format (//host/share/path) and the folder exists.
- Make sure the network directory is readable and writeable.
- If you are using the default file names for scanned files, make sure there are no conflicting file names. Remove some of the previously scanned files.
- Use the IP address instead of the host name. Make sure the product and host are connected to the same network.
- If the network folder is password protected, make sure to enter the correct user name and password.
- If a [Disk full](#) message displays, remove some files from the network folder.
- Turn the product off, and then on. Scan again.

Solve fax quality problems

Check the scanner glass for dirt and smudges

Over time, specks of debris might collect on the scanner glass and white plastic backing, which can affect performance. Use the following procedure to clean the scanner.

1. Use the power switch to turn off the product, and then unplug the power cord from the electrical socket.



2. Open the scanner lid.
3. Clean the scanner glass, the document feeder strips, and the white plastic backing with a soft cloth or sponge that has been moistened with nonabrasive glass cleaner.


CAUTION: Do not use abrasives, acetone, benzene, ammonia, ethyl alcohol, or carbon tetrachloride on any part of the product; these can damage the product. Do not place liquids directly on the glass or platen. They might seep and damage the product.



4. Dry the glass and white plastic parts with a chamois or a cellulose sponge to prevent spotting.
5. Plug in the product, and then use the power switch to turn on the product.

Check the send-fax resolution setting

If the product was unable to send a fax because the receiving fax machine did not answer or was busy, the product attempts to redial based on the redial-on-busy, redial-on-no-answer, and redial-on-communication-error options.

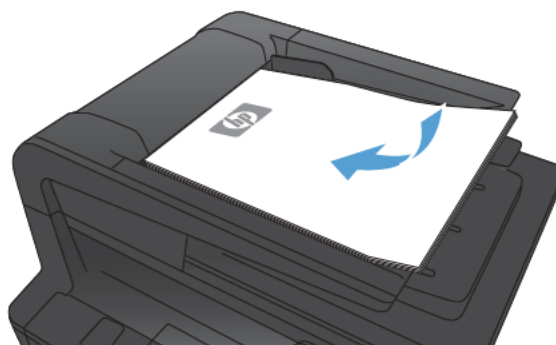
1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the **Fax Setup** menu.
3. Touch the **Advanced Setup** menu.
4. Open the **Fax Resolution** menu.

Optimize for text or pictures

The following copy-quality settings are available:

- **Auto Select:** Use this setting when you are not concerned about the quality of the copy. This is the default setting.
- **Mixed:** Use this setting for documents that contain a mixture of text and graphics.
- **Text:** Use this setting for documents that contain mostly text.
- **Picture:** Use this setting for documents that contain mostly graphics.

1. Load the document onto the scanner glass or into the document feeder.




2. From the Home screen on the product control panel, touch the **Copy** button.
3. Touch the **Settings** button, and then scroll to and touch the **Optimize** button. Touch the arrow buttons to scroll through the options, and then touch an option to select it.
4. Touch the **Start Copy** button to start copying.

Check the error correction setting

Usually, the product monitors the signals on the telephone line while it is sending or receiving a fax. If the product detects an error during the transmission and the error-correction setting is **On**, the product can request that the portion of the fax be resent. The factory-set default for error correction is **On**.

You should turn off error correction only if you are having trouble sending or receiving a fax, and you are willing to accept the errors in the transmission. Turning off the setting might be useful when you are trying to send a fax overseas or receive one from overseas, or if you are using a satellite telephone connection.

1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the **Service** menu.
3. Touch the **Fax Service** menu.
4. Touch the **Error Correction** button, and then touch the **On** button.

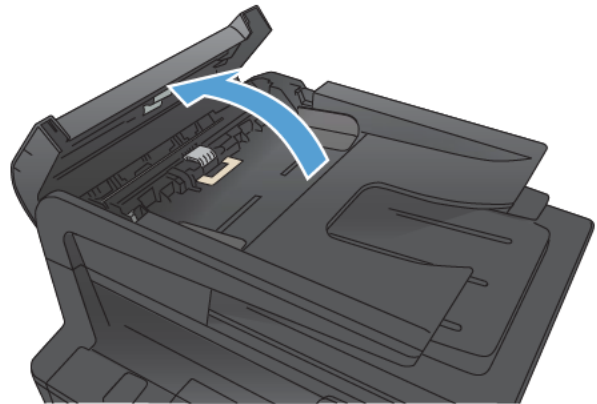
Send to a different fax machine

Send the fax job to a different fax machine to see if another machine will successfully receive the fax job.

Clean the pickup rollers and separation pad in the document feeder

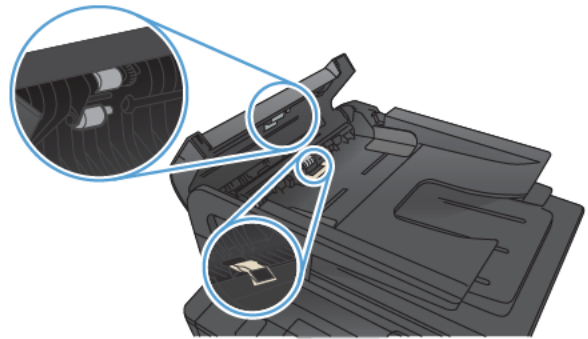
If the product document feeder experiences paper-handling problems, such as jams or multiple-page feeds, clean the document feeder rollers and separation pad.

1. Open the document feeder cover.

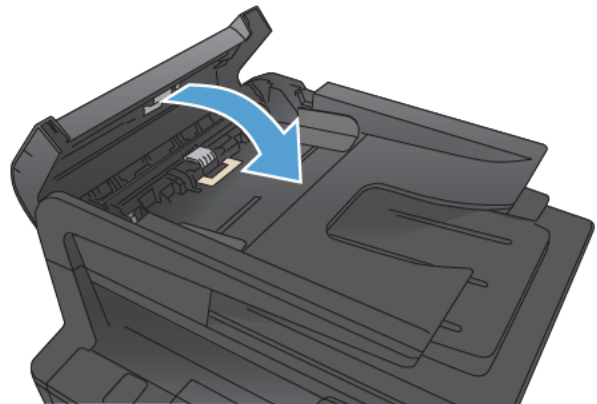


2. Use a moist, lint-free cloth to wipe both pickup rollers and the separation pad to remove dirt.

CAUTION: Do not use abrasives, acetone, benzene, ammonia, ethyl alcohol, or carbon tetrachloride on any part of the product; these can damage the product. Do not place liquids directly on the glass or platen. They might seep and damage the product.



3. Close the document feeder cover.




Check the fit-to-page setting

If the product printed a fax job off the page, turn on the fit-to-page feature from the product control panel.



NOTE: Make sure that the default paper size setting matches the size of the paper in the tray.


1. From the Home screen on the product control panel, touch the Setup  button.
2. Touch the **Fax Setup** menu.
3. Touch the **Advanced Setup** menu.
4. Touch the **Fit to Page** button, and then touch the **On** button.

Check the sender's fax machine

Ask the sender to darken the contrast setting on the sending fax machine, and then resend the fax.

Perform a fax diagnostic test

From the product control panel, you can run a diagnostic test that provides information about the product fax settings.

1. From the Home screen on the product control panel, touch the Setup  button.
2. Open the following menus
 - [System Setup](#)
 - [Self Diagnostics](#)
3. Touch the [Run Fax Test](#) button to start the test. The product prints a test page that shows test results.

The product does not print or it prints slowly

The product does not print

If the product does not print at all, try the following solutions.

1. Make sure the product is turned on and that the control panel indicates it is ready.
 - If the control panel does not indicate the product is ready, turn the product off and then on again.
 - If the control panel indicates the product is ready, try sending the job again.
2. If the control panel indicates the product has an error, resolve the error and then try sending the job again.
3. Make sure the cables are all connected correctly. If the product is connected to a network, check the following items:
 - Check the light next to the network connection on the product. If the network is active, the light is green.
 - Make sure that you are using a network cable and not a phone cord to connect to the network.
 - Make sure the network router, hub, or switch is turned on and that it is working correctly.
4. Install the HP software from the CD that came with the product. Using generic print drivers can cause delays clearing jobs from the print queue.
5. From the list of printers on your computer, right-click the name of this product, click **Properties**, and open the **Ports** tab.
 - If you are using a network cable to connect to the network, make sure the printer name listed on the **Ports** tab matches the product name on the product configuration page.
 - If you are using a USB cable and are connecting to a wireless network, make sure the box is checked next to **Virtual printer port for USB**.
6. If you are using a personal firewall system on the computer, it might be blocking communication with the product. Try temporarily disabling the firewall to see if it is the source of the problem.
7. If your computer or the product is connected to a wireless network, low signal quality or interference might be delaying print jobs.

The product prints slowly

If the product prints, but it seems slow, try the following solutions.

1. Make sure the computer meets the minimum specifications for this product. For a list of specifications, go to this Web site: www.hp.com/support/ljm425series.
2. When you configure the product to print on some paper types, such as heavy paper, the product prints more slowly so it can correctly fuse the toner to the paper. If the paper type setting is not correct for the type of paper you are using, change the setting to the correct paper type.
3. If your computer or the product is connected to a wireless network, low signal quality or interference might be delaying print jobs.

Solve walk-up USB printing problems

- [The USB Flash Drive menu does not open when you insert the USB accessory](#)
- [The file does not print from the USB storage accessory](#)
- [The file that you want to print is not listed in the USB Flash Drive menu](#)

The USB Flash Drive menu does not open when you insert the USB accessory

1. You might be using a USB storage accessory or a file system that this product does not support. Save the files on a standard USB storage accessory that uses File Allocation Table (FAT) file systems. The product supports FAT12, FAT16, and FAT32 USB storage accessories.
2. If another menu is already open, close that menu and then reinsert the USB storage accessory.
3. The USB storage accessory might have multiple partitions. (Some USB storage accessory manufacturers install software on the accessory that creates partitions, similar to a CD.) Reformat the USB storage accessory to remove the partitions, or use a different USB storage accessory.
4. The USB storage accessory might require more power than the product can provide.
 - a. Remove the USB storage accessory.
 - b. Turn the product off and then on.
 - c. Use a USB storage accessory that has its own power supply or that requires less power.
5. The USB storage accessory might not be functioning correctly.
 - a. Remove the USB storage accessory.
 - b. Turn the product off and then on.
 - c. Try printing from another USB storage accessory.

The file does not print from the USB storage accessory

1. Make sure paper is in the tray.
2. Check the control panel for messages. If paper is jammed in the product, clear the jam.

The file that you want to print is not listed in the USB Flash Drive menu

1. You might be trying to print a file type that the USB printing feature does not support. The product supports .PDF and .JPEG file types.
2. You might have too many files in a single folder on the USB storage accessory. Reduce the number of files in the folder by moving them to subfolders.
3. You might be using a character set for the file name that the product does not support. In this case, the product replaces the file names with characters from a different character set. Rename the files using ASCII characters.

Solve direct connection problems

If you have connected the product directly to a computer, check the cable.

- Verify that the cable is connected to the computer and to the product.
- Verify that the cable is not longer than 5 m (16.4 ft). Try using a shorter cable.
- Verify that the cable is working correctly by connecting it to another product. Replace the cable if necessary.

Solve wired network problems

Check the following items to verify that the product is communicating with the network. Before beginning, print a configuration page from the product control panel and locate the product IP address that is listed on this page.

- [Poor physical connection](#)
- [The computer is using the incorrect IP address for the product](#)
- [The computer is unable to communicate with the product](#)
- [The product is using incorrect link and duplex settings for the network](#)
- [New software programs might be causing compatibility problems](#)
- [The computer or workstation might be set up incorrectly](#)
- [The product is disabled, or other network settings are incorrect](#)



NOTE: HP does not support peer-to-peer networking, as the feature is a function of Microsoft operating systems and not of the HP print drivers. For more information, go to Microsoft at www.microsoft.com.

Poor physical connection

1. Verify that the product is attached to the correct network port using a cable of the correct length.
2. Verify that cable connections are secure.
3. Look at the network port connection on the back of the product, and verify that the amber activity light and the green link-status light are lit.
4. If the problem continues, try a different cable or port on the hub.

The computer is using the incorrect IP address for the product

1. Open the printer properties and click the **Ports** tab. Verify that the current IP address for the product is selected. The product IP address is listed on the product configuration page.
2. If you installed the product using the HP standard TCP/IP port, select the box labeled **Always print to this printer, even if its IP address changes**.
3. If you installed the product using a Microsoft standard TCP/IP port, use the hostname instead of the IP address.
4. If the IP address is correct, delete the product and then add it again.

The computer is unable to communicate with the product

1. Test network communication by pinging the network.

- a. Open a command-line prompt on your computer. For Windows, click **Start**, click **Run**, and then type `cmd`.
 - b. Type `ping` followed by the IP address for your product.

For Mac OS X, open the Network Utility, and then supply the IP address in the correct field in the **Ping** pane.
 - c. If the window displays round-trip times, the network is working.
2. If the ping command failed, verify that the network hubs are on, and then verify that the network settings, the product, and the computer are all configured for the same network.

The product is using incorrect link and duplex settings for the network

Hewlett-Packard recommends leaving this setting in automatic mode (the default setting). If you change these settings, you must also change them for your network.

New software programs might be causing compatibility problems

Verify that any new software programs are correctly installed and that they use the correct print driver.

The computer or workstation might be set up incorrectly

1. Check the network drivers, print drivers, and the network redirection.
2. Verify that the operating system is configured correctly.

The product is disabled, or other network settings are incorrect

1. Review the configuration page to check the status of the network protocol. Enable it if necessary.
2. Reconfigure the network settings if necessary.

Solve wireless network problems

Wireless connectivity checklist

- Verify that the network cable is not connected.
- Verify that the product and the wireless router are turned on and have power. Also make sure that the wireless radio in the product is turned on.
- Verify that the service set identifier (SSID) is correct. Print a configuration page to determine the SSID. If you are not sure the SSID is correct, run the wireless setup again.
- With secured networks, verify that the security information is correct. If the security information is incorrect, run the wireless setup again.
- If the wireless network is working correctly, try accessing other computers on the wireless network. If the network has Internet access, try connecting to the Internet over a wireless connection.
- Verify that the encryption method (AES or TKIP) is the same for the product as it is for the wireless access point (on networks using WPA security).
- Verify that the product is within the range of the wireless network. For most networks, the product must be within 30 m (100 ft) of the wireless access point (wireless router).
- Verify that obstacles do not block the wireless signal. Remove any large metal objects between the access point and the product. Make sure poles, walls, or support columns containing metal or concrete do not separate the product and wireless access point.
- Verify that the product is located away from electronic devices that might interfere with the wireless signal. Many devices can interfere with the wireless signal including motors, cordless phones, security system cameras, other wireless networks, and some Bluetooth devices.
- Verify that the print driver is installed on the computer.
- Verify that you have selected the correct printer port.
- Verify that the computer and product connect to the same wireless network.
- For Mac OS X, verify that the wireless router supports Bonjour.

The product does not print after the wireless configuration completes

1. Make sure that the product is turned on and in the ready state.
2. Turn off any third-party firewalls on your computer.
3. Make sure that the wireless network is working correctly.
4. Make sure that your computer is working correctly. If necessary, restart the computer.
5. Verify that you can open the product HP Embedded Web Server from a computer on the network.

The product does not print, and the computer has a third-party firewall installed

1. Update the firewall with the most recent update available from the manufacturer.
2. If programs request firewall access when you install the product or try to print, make sure you allow the programs to run.
3. Temporarily turn off the firewall, and then install the wireless product on the computer. Enable the firewall when you have completed the wireless installation.

The wireless connection does not work after moving the wireless router or product

1. Make sure that the router or product connects to the same network that your computer connects to.
2. Print a configuration page.
3. Compare the service set identifier (SSID) on the configuration page to the SSID in the printer configuration for the computer.
4. If the numbers are not the same, the devices are not connecting to the same network. Reconfigure the wireless setup for the product.

Cannot connect more computers to the wireless product

1. Make sure that the other computers are within the wireless range and that no obstacles block the signal. For most networks, the wireless range is within 30 m (100 ft) of the wireless access point.
2. Make sure that the product is turned on and in the ready state.
3. Turn off any third-party firewalls on your computer.
4. Make sure that the wireless network is working correctly.
5. Make sure that your computer is working correctly. If necessary, restart the computer.

The wireless product loses communication when connected to a VPN

- Typically, you cannot connect to a VPN and other networks at the same time.

The network does not appear in the wireless networks list

- Make sure the wireless router is turned on and has power.
- The network might be hidden. However, you can still connect to a hidden network.

The wireless network is not functioning


1. Make sure that the network cable is not connected.
2. To verify if the network has lost communication, try connecting other devices to the network.
3. Test network communication by pinging the network.

- a. Open a command-line prompt on your computer. For Windows, click **Start**, click **Run**, and then type `cmd`.
 - b. Type `ping` followed by the router IP address.

For Mac OS X, open the Network Utility, and then supply the IP address in the correct field in the **Ping** pane.
 - c. If the window displays round-trip times, the network is working.
4. Make sure that the router or product connects to the same network that the computer connects to.
 - a. Print a configuration page.
 - b. Compare the service set identifier (SSID) on the configuration report to the SSID in the printer configuration for the computer.
 - c. If the numbers are not the same, the devices are not connecting to the same network. Reconfigure the wireless setup for the product.

Perform a wireless network diagnostic test

From the product control panel, you can run a diagnostic test that provides information about the wireless network settings.

1. From the Home screen on the product control panel, touch the Setup  button.
2. Open the following menus
 - [System Setup](#)
 - [Self Diagnostics](#)
3. Touch the [Run Network Test](#) button to start the test. The product prints a test page that shows test results.

Reduce interference on a wireless network

The following tips can reduce interference in a wireless network:

- Keep the wireless devices away from large metal objects, such as filing cabinets, and other electromagnetic devices, such as microwaves and cordless telephones. These objects can disrupt radio signals.
- Keep the wireless devices away from large masonry structures and other building structures. These objects can absorb radio waves and lower signal strength.
- Position the wireless router in a central location in line of sight with the wireless products on the network.

Solve product software problems with Windows

A print driver for the product is not visible in the Printer folder

1. Reinstall the product software.



NOTE: Close any applications that are running. To close an application that has an icon in the system tray, right-click the icon, and select **Close** or **Disable**.

2. Try plugging the USB cable into a different USB port on the computer.

An error message was displayed during the software installation

1. Reinstall the product software.



NOTE: Close any applications that are running. To close an application that has an icon in the system tray, right-click the icon, and select **Close** or **Disable**.

2. Check the amount of free space on the drive where you are installing the product software. If necessary, free up as much space as you can, and reinstall the product software.
3. If necessary, run the Disk Defragmenter, and reinstall the product software.

The product is in Ready mode, but nothing prints

1. Print a configuration page, and verify the product functionality.
2. Verify that all of the cables are correctly seated and within specifications. This includes the USB and power cables. Try a new cable.
3. Verify the IP address on the configuration page matches the IP address for the software port. Use one of the following procedures:

Windows XP, Windows Server 2003, Windows Server 2008, and Windows Vista

- a. Click **Start**.
- b. Click **Settings**.
- c. Click **Printers and Faxes** (using the default Start menu view) or click **Printers** (using the Classic Start menu view).
- d. Right-click the product driver icon, and then select **Properties**.
- e. Click the **Ports** tab, and then click **Configure Port**.
- f. Verify the IP address, and then click **OK** or **Cancel**.
- g. If the IP addresses are not the same, delete the driver, and reinstall the driver using the correct IP address.

Windows 7

- a. Click **Start**.
- b. Click **Devices and Printers**.
- c. Right-click the product driver icon, and then select **Printer properties**.

- d. Click the **Ports** tab, and then click **Configure Port**.
- e. Verify the IP address, and then click **OK** or **Cancel**.
- f. If the IP addresses are not the same, delete the driver, and reinstall the driver using the correct IP address.

Solve product software problems with Mac OS X

- [The print driver is not listed in the Print & Fax or Print & Scan list](#)
- [The product name does not appear in the product list in the Print & Fax or Print & Scan list](#)
- [The print driver does not automatically set up the selected product in the Print & Fax or Print & Scan list](#)
- [A print job was not sent to the product that you wanted](#)
- [When connected with a USB cable, the product does not appear in the Print & Fax or Print & Scan list after the driver is selected.](#)
- [You are using a generic print driver when using a USB connection](#)

The print driver is not listed in the Print & Fax or Print & Scan list

1. Make sure that the product .GZ file is in the following hard-drive folder: `Library/Printers/PPDs/Contents/Resources`. If necessary, reinstall the software.
2. If the GZ file is in the folder, the PPD file might be corrupt. Delete the file and then reinstall the software.

The product name does not appear in the product list in the Print & Fax or Print & Scan list

1. Make sure that the cables are connected correctly and the product is on.
2. Print a configuration page to check the product name. Verify that the name on the configuration page matches the product name in the **Print & Fax (Print & Scan** in Mac OS X v10.7) list.
3. Use the + button to add the product to the **Print & Fax (Print & Scan** in Mac OS X v10.7) list.
4. Replace the USB or network cable with a high-quality cable.

The print driver does not automatically set up the selected product in the Print & Fax or Print & Scan list

1. Make sure that the cables are connected correctly and the product is on.
2. Make sure that the product .GZ file is in the following hard-drive folder: `Library/Printers/PPDs/Contents/Resources`. If necessary, reinstall the software.
3. If the GZ file is in the folder, the PPD file might be corrupt. Delete the file and then reinstall the software.
4. Use the + button to add the product to the **Print & Fax (Print & Scan** in Mac OS X v10.7) list.
5. Replace the USB or network cable with a high-quality cable.

A print job was not sent to the product that you wanted

1. Open the print queue and restart the print job.
2. Another product with the same or similar name might have received your print job. Print a configuration page to check the product name. Verify that the name on the configuration page matches the product name in the **Print & Fax (Print & Scan** in Mac OS X v10.7) list.

When connected with a USB cable, the product does not appear in the **Print & Fax** or **Print & Scan** list after the driver is selected.

Software troubleshooting

1. Make sure that your Mac operating system is Mac OS X 10.5 or later.
2. Use the **+** button to add the product to the **Print & Fax** (**Print & Scan** in Mac OS X v10.7) list.

Hardware troubleshooting

1. Make sure that the product is turned on.
2. Make sure that the USB cable is connected correctly.
3. Make sure that you are using the appropriate Hi-Speed USB cable.
4. Make sure that you do not have too many USB devices drawing power from the chain. Disconnect all of the devices from the chain, and then connect the cable directly to the USB port on the computer.
5. Check to see if more than two non-powered USB hubs are connected in a row on the chain. Disconnect all of the devices from the chain, and then connect the cable directly to the USB port on the computer.



NOTE: The iMac keyboard is a non-powered USB hub.

You are using a generic print driver when using a USB connection

If you connected the USB cable before you installed the software, you might be using a generic print driver instead of the driver for this product.

1. Delete the generic print driver.
2. Reinstall the software from the product CD. Do not connect the USB cable until the software installation program prompts you.
3. If multiple printers are installed, make sure that you have selected the correct printer in the **Format For** drop-down menu in the **Print** dialog box.

Remove software (Windows)

Windows XP

1. Click **Start**, and then click **Programs**.
2. Click **HP**, and then click the product name.
3. Click **Uninstall**, and then follow the onscreen instructions to remove the software.

Windows Vista and Windows 7

1. Click **Start**, and then click **All Programs**.
2. Click **HP**, and then click the product name.
3. Click **Uninstall**, and then follow the onscreen instructions to remove the software.

Remove software (Mac OS X)

You must have administrator rights to remove the software.

1. Disconnect the product from the computer.
2. Open **Applications**.
3. Select **Hewlett Packard**.
4. Select **HP Uninstaller**.
5. Select the product from the list of devices, and then click the **Uninstall** button.
6. After the software is uninstalled, restart the computer and empty the Trash.

9 Supplies and accessories

- [Order parts, accessories, and supplies](#)
- [HP policy on non-HP supplies](#)
- [HP anticounterfeit Web site](#)

Order parts, accessories, and supplies

HP original toner cartridge and paper	www.hp.com/go/suresupply
Order genuine HP parts or accessories	www.hp.com/buy/parts
Order through service or support providers	Contact an HP-authorized service or support provider.

Item	Part number	Cartridge number	Description
HP LaserJet toner cartridge	CF280A (standard)	80A	Black toner cartridge
	CF280X (extended)	80X	
Input tray	CF284A		500-sheet Tray 3
USB 2.0 printer cable	C6518A		(2-meter standard) A-to-B cable

HP policy on non-HP supplies

Hewlett-Packard Company cannot recommend the use of non-HP toner cartridges, either new or remanufactured.



NOTE: For HP printer products, the use of a non-HP toner cartridge or a refilled toner cartridge does not affect either the warranty to the customer or any HP support contract with the customer. However, if product failure or damage is attributable to the use of a non-HP toner cartridge or refilled toner cartridge, HP will charge its standard time and materials charges to service the product for the particular failure or damage.

HP anticounterfeit Web site

Go to www.hp.com/go/anticounterfeit when you install an HP toner cartridge and the control-panel message says the cartridge is non-HP. HP will help determine if the cartridge is genuine and take steps to resolve the problem.

Your toner cartridge might not be a genuine HP toner cartridge if you notice the following:

- The supplies status page indicates that a non-HP supply is installed.
- You are experiencing a high number of problems with the toner cartridge.
- The cartridge does not look like it usually does (for example, the packaging differs from HP packaging).

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CF286-91027



Appendix D1

Attorneys Eyes Only Pursuant to Protective Order

Exhibit A

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Exhibit B

Howard Declaration Ex. 1(A)

(PLACEHOLDER)

UNREDACTED NATIVE VERSION OF DOCUMENT
TO BE FILED SEPARATELY UNDER SEAL PURSUANT TO LR 5.3(b)(3)(B)(iii)

Howard Declaration Ex. 1(B)

(PLACEHOLDER)

UNREDACTED NATIVE VERSION OF DOCUMENT
TO BE FILED SEPARATELY UNDER SEAL PURSUANT TO LR 5.3(b)(3)(B)(iii)

Howard Declaration Ex. 2

(Supplemental Rebuttal) Expert Report Dated December 21, 2021

REDACTED VERSION OF DOCUMENT
TO BE FILED UNDER SEAL PURSUANT TO LR 5.3(b)(3)(B)(iii)

**IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF MICHIGAN
SOUTHERN DIVISION**

MATTHEW N. FULTON, DDS, P.C.,)	
individually and on behalf of all others)	
similarly situated,)	
)	
Plaintiffs,)	Case No. 16-cv-13777
v.)	Hon. Denise Page Hood
)	
ENCLARITY, INC., LEXISNEXIS RISK)	
SOLUTIONS INC., LEXISNEXIS RISK)	
SOLUTIONS GA INC., LEXISNEXIS RISK)	
SOLUTIONS FL INC.,)	
)	
Defendants.)	
)	

(Supplemental Rebuttal) Expert Report of Lee Howard

1. A complete statement of all opinions I will express and the basis and reasons for same, the facts or data considered by me in forming same, and the documents used to summarize and support same are as follows.

2. I am not a party to this matter.

3. I have acknowledged and agreed to be bound by the protective order as to confidentiality in this case.

4. I have previously provided a report in this matter dated 29 September 2021, and I hereby supplement that report with the following.

5. I have read and examined the following reports and transcripts provided to me by plaintiff's counsel:

- a. Expert Report of Bruce Deal; November 19, 2021
- b. Expert Report of James Bress; November 19, 2021
- c. Rough Transcript of Deposition of Bruce Deal; December 16, 2021
- d. Rough Transcript of Deposition of James Bress; December 20, 2021

6. Beginning in the last paragraph on page 8 of his report, Mr. Bress appears to attempt to draw some kind of distinction between various kinds of telephone circuits or lines, specifically T1 trunks, and the term "regular telephone line". In doing so, it seems that Mr. Bress is incorrectly trying to conclude that the term "regular telephone line" can only refer to analog lines also known as analog loop circuits and "POTS" (plain old telephone system) lines. However, "regular telephone line" is not a specific or technical term within the telephone service industry and can only be understood colloquially. To illustrate this, I provide a copy of Verizon's web advertisement for their analog lines as Appendix 1. At no point does the advertisement use the words "regular telephone line" in reference to analog loop circuits. While I have no doubt that some people have occasionally referred to analog loop circuits as "regular telephone lines", I know of no

reason to conclude that an analog loop circuit is always a “regular telephone line”. Likewise, I know of no reason to conclude that other types of telephone circuits are not “regular telephone lines”.

7. To elaborate this explanation, the physical analog phone interface cords are known as “wires” or more properly as “cables”. The wiring alone is not properly known as a “telephone line”. If one connects an analog phone cable to a machine then technicians and others familiar with the telephone service industry would not say that the machine is connected to a “telephone line” until the other end of the cable is properly connected to a serviced connection by the telephone service provider. If the cable is left disconnected from the telephone service provider then the machine is merely connected to a “cable” and is not connected to a “telephone line”. It is the availability of the telephone service that constitutes the machine’s connection to a “telephone line” and not the specific variety of hardware interfacing used.

8. The understanding that telephone services are inherently required for a “telephone line” is demonstrated in the meaning of terms such as “line sharing” and “party line” in the telephony industry. While “line sharing” and “party line” may involve a physically shared wire or cable this also may not be the case; however, both terms describe a shared telephone service. Modem chipsets such as the Silicon Labs Si2435 and Conexant CX81801 produce responses such as “NO LINE” and “LINE IN USE”, both of

which refer to the telephone service either being unavailable and neither of which refer specifically to the absence of a physically attached telephone cable. Such responses are analogous to “NO DIAL TONE” responses in other modem chipsets.

9. In 1991 and for many years prior, the typical fax call between two remote endpoints using standalone fax machines would have used an analog loop circuit only from each fax machine to their respective telephone service providers’ Class 5 switch equipment, likely at their central offices (as pointed out in Appendix 1). Between the two providers’ central offices would have been a series of other types of telephony circuits such as T1s, DS3s, and OC3s connections. (T1s are digital circuits comprising 24 channels or lines. DS3s are digital circuits comprising 28 T1s or 672 lines. OC3s are digital circuits which operate on optical cables and comprise 3 DS3s or 2,016 lines.) So, the fax “line” between two such endpoints would regularly traverse T1s, T3s, and OC3s in addition to the analog loops. Additionally, the OC3 connections would involve fiber optic or radio communications rather than copper wires. The “regular telephone line” in 1991 involved all of these types of circuits and connections.

10. Today we also have telephony circuits that involve Voice Over Internet Protocol (VoIP or “SIP trunks”). Such circuits are merely an addition to the variety of telephony circuit types involved in regular telephone lines that have been in use since before 1991. A machine connected to an analog VoIP ATA which is configured with

connectivity to a VoIP service provider may also be described as being connected to a “regular telephone line” even though the call at least partially traverses a VoIP call path. This is completely understandable because the meaning of “regular telephone line” indicates that the line can be used to make regular telephone calls.

11. That the regular telephone line may also involve VoIP services is evidenced by a recent news announcement given October 1, 2021 by AT&T entitled, “AT&T Gives Business ‘Plain-Old’ Phone Service a Cloud Makeover”. I provide a copy of this announcement at Appendix 2. In this announcement AT&T describes the “modernizing” of analog loop circuits by “pairing the reliability of POTS with voice quality, security and lower maintenance costs of digital lines”. The announcement never describes the VoIP service it is soliciting as something fundamentally different from an analog line or that it is not a regular telephone line. Likewise the announcement clearly suggests that there is a functional equivalence between the offered VoIP services and traditional analog loop circuits. It even quotes an AT&T vice president as saying that their VoIP services maintain “the reliability and regulatory compliance” traditionally had by analog loop circuits.

12. On page 5 of his report Mr. Bress states that he has “been the main architect for, and a user of, test equipment designed specifically to test signaling over regular telephone lines” and cites as an example of such equipment the TSA-6000 made by AST

Technology Labs, his employer. I provide a copy of the web page that AST Technology Labs has for the TSA-6000 as Appendix 3. On this page it states that the TSA-6000 is “for use in VoIP and Set top box terminal adaptors testing” as the very first use case. The description in this page for the TSA-6000 does not limit the use of the TSA-6000 to analog loop circuits. It seems odd to me that Mr. Bress would cite the TSA-6000 as “equipment designed specifically to test signaling over regular telephone lines” and then later in his report (on page 27) claim that VoIP lines are not “regular telephone lines” when that very equipment is used for testing VoIP lines.

13. As an example that faxing directly from one or more T1 lines occurred before Mr. Bress suggests would have been the case, beginning in 1996-1997 Digi International started commercially selling products known as “Digi Acceleport T1 Modem Bank” and “Digi DataFire RAS”. These provided an interface for any Class 1 or Class 2 computer fax server software to send and receive faxes directly from one or more T1 lines. Digi International’s Securities and Exchange Commission annual report filing for the fiscal year ending September 30, 1999 (Appendix 4) states that net sales of this family of products were \$8.7 million for 1999 and \$8.1 million for 1998. These products were components of Digi International’s server-based communication adapter products which “constituted approximately 90%, 80%, and 76% of net sales in fiscal 1999, 1998, and 1997,

respectively.” Thus, such systems were not “experimental” or “limited in deployment” as Mr. Bress suggests would have been the case during the 1990s.

14. On page 9 of his report Mr. Bress states, “Since 1991 when the TCPA was passed, the methods used for the transmission of fax documents has changed.” His report then goes on to explain how internet, email, and cloud-based servers have been included into the use of fax operations. While the full end-to-end communication path between a human fax document sender and a human fax document receiver has evolved to include various internet connection paths in addition to the PSTN (Public Switched Telephone Network) path, the standardized fax protocol, ITU T.30, has not materially changed since 1991, and the transmission of faxes to numbers designated by NANPA still requires use of the PSTN.

15. On page 10 of his report Mr. Bress states that “access issues” are not a concern to online fax services and that concerns about “access time” do not apply regarding online fax services. This understanding is completely incorrect. Online fax service providers inherently have a limited (albeit often large) capacity to conduct its fax communication services on behalf of its customers. For example, a single T1 PRI has 23 channels (or “telephone lines”) on which it can send and receive faxes. If some portion of those channels are consumed by reception of undesired or unsolicited facsimile advertising then the service provider is required to expand its service capacity to account

for the senders' advertising and the senders have shifted a portion of the costs of their advertising onto the recipients' fax service service providers (which, in turn, get passed onto their customers).

16. Fax service providers which use VoIP, FoIP (fax over IP), T.38, or other internet faxing mechanisms are not exempt from this inherent concern. Although internet connection bandwidth is, itself, not unlimited – the saturation of which will severely degrade the quality and speed of the fax communication – the eventual PSTN connectivity by those fax over IP calls will be even more greatly limited. At the point that a fax service provider's eventual PSTN connections become saturated, the service provider will not be able to receive or make any additional fax calls for its legitimate business use. So, if some portion of those calls are consumed by reception of unsolicited advertising, then likewise there is some portion of costs which the sender is eventually shifting onto the receiver through costs to the online service provider.

17. Mr. Bress appears to acknowledge the telephone line capacity limitations had by online fax service providers when he states on page 29 of his report that “the probability of incoming calls being blocked due to a busy condition is ***almost*** eliminated” (emphasis mine). He appears to understand, then, that if an online fax service provider were operating with a single T1 PRI connection to the PSTN and that if all 23 channels were consumed by receiving unsolicited fax advertising that any subsequent calls by fax

senders for legitimate purposes would fail due to a busy condition (technically referred to as “congestion”).

18. Mr. Bress uses the FCC’s declaratory ruling in the Amerifactors case as a primary source for opinions expressed in his report. In the Amerifactors case the FCC sought comment on Amerifactors’ petition. The FCC appears to have made its ruling based on and limited to comments received. This is evidenced by the statement made in paragraph 8 of the ruling, “Our clarification is limited to an analysis of online fax services, as informed by the current record, and does not prejudice whether we would arrive at the same conclusion for other types of equipment and services.” As I explained in my earlier deposition, I do not have an opinion on the legal effect of the Amerifactors petition; however, I do believe that some of the technical information was incorrect which was presented to the FCC for the Amerifactors ruling.

19. It would appear that part of that record as described in the FCC ruling in Amerifactors was that “a fax received by an online fax service as an electronic message is effectively an email.” This is incorrect. Online fax services receive faxes via ITU T.30 fax protocol over regular telephone lines just the same as any fax communication occurs. However, online fax services may deliver those received faxes to their customers as email.

20. In the Amerifactors ruling the FCC states, “Consumers can manage those messages the same way they manage email by blocking senders or deleting incoming

messages without printing them.” This is incorrect. In the condition that faxes are delivered by the online fax service provider to the recipient by email, then the email is being sent by the recipient’s fax service provider and not by the original sender of the fax. If the recipient blocks emails coming from their fax service provider then they will not receive any of their faxes, including faxes which are not unsolicited advertising.

21. Speaking of “the costs of advertising [being shifted] from the sender to the recipient”, the ruling states “The record is clear that faxes sent to online fax services do not pose these harms and, in fact give consumers tools such as blocking capabilities to control these costs.” This is also incorrect. As explained above, there are very real costs which will be borne by the online fax service provider which will, in turn, need to pass those costs along to its customers. Furthermore, as explained above, there is no means for the online fax service customers to block such faxes without blocking legitimate faxes from other senders.

22. Likewise, the online fax service provider, itself, has no capability to discern an unsolicited fax advertisement from other legitimate fax traffic. If the online fax service provider were to block based on the sender’s CallerID, DCS, or TSID signals it would invariably end up blocking otherwise legitimate faxes from other senders.

23. The FCC’s ruling also states, “Faxes sent to online fax services use paper and ink only when the recipient chooses to print it using their own separately provided

equipment.” In so doing, the FCC’s ruling explains exactly how such faxes were sent to “equipment which has the capacity... to transcribe text or images, or both, from an electronic signal received over a regular telephone line onto paper.”

24. On page 14 his report Mr. Bress suggests that the Transmission Data should have included some mention of MCF signals in order for them to have been considered successful. In so doing he seems to have ignored my first report in this matter where I explained that a successful fax delivery is synonymous with the receipt of an MCF signal by the sender as sent by the receiver. Therefore, because the “deliveries” field in the Transmission Data was defined by Mr. Bergman as representing successful fax transmissions the Transmission Data contains sufficient information to conclude a successful transmission. The “deliveries” field is defined by itself to represent successful transmissions which can only correspond to the receipt of an MCF signal by the sender as sent by the receiver.

25. On page 15 of his report Mr. Bress suggests that I should have treated the “deliveries” field in the Transmission Data as unreliable because:

- a. I have no personal knowledge of how the “deliveries” information was generated.
- b. I am not familiar with the specific Sfax product that was provided to Enclarity.

- c. I am not familiar with Sfax's procedures with respect to programming and operating its equipment.
- d. I have no familiarity with how Sfax sends faxes.
- e. I have not evaluated the service Sfax provided to Enclarity.
- f. I have no personal knowledge of Sfax's procedures for programming or operating its equipment.

26. [REDACTED]

[REDACTED] I have seen no evidence or testimony given in this case that contradicts Mr. Bergman's testimony on this matter. Furthermore, Mr. Bergman's testimony is consistent with my experience in how such records are made and kept. Thus, I have not doubted the accuracy of Mr. Bergman's statement.

27. I have seen no evidence or testimony given in this case which suggests that Sfax's procedures with respect to programming and operating its equipment would call into question the accuracy of the "deliveries" field in the Transmission Data. Furthermore, it is my experience that the type of data that Sfax provided to Enclarity is consistent with automated business data that may be treated as reliable. Thus, I have not doubted the accuracy of the Sfax data provided to Enclarity.

28. As fax protocol is standardized by ITU T.30 I can rely on that standardization and do not, therefore, need to consider any particular ancillary methods

by which Sfax employs T.30 unless evidence is given that suggests that Sfax did not follow the standards. I can, therefore, rely on an assertion of a successful fax to represent what it means in ITU T.30.

29. On pages 15 and 16 of his report, Mr. Bress suggests that the only means to conclude that Sfax's fax operations were functioning correctly would be to produce additional evidence that the data reported by Sfax has been validated or tested or that quality assurance was applied to confirm this data. I disagree. As acknowledged by Mr. Bress at the outset of this argument, there are 12 individual hard-copies of faxes demonstrating the functionality and reliability of the Transmission Data. Mr. Bress offers no evidence to conclude that the Sfax fax operations were not functioning correctly. Mr. Bress did not show how any any of the 12 individual hard-copies of faxes were a poor representation of the Transmission Data as a whole.

30. [REDACTED]

[REDACTED]

[REDACTED] However, Mr. Bress ignores the fact that Enclarity was continually receiving returned faxes from recipients, phone calls, and requests indicating that the faxes were, indeed, being successfully received. Neither Mr. Bergman nor Mr. Szymanski described any recorded reports of flaws or recorded complaints about

inaccurate reporting. Neither has Mr. Bress produced any such recorded reports of faulty operation by Sfax.

31. On page 29 of Mr. Bress's report he creates a straw man argument as he attempts to take my deposition testimony out of context regarding a hypothetical "regular telephone". The whole of my testimony during that portion of the deposition shows that there was a specific hypothetical analog telephone which the defense attorney defined as a "regular telephone", distinguished from other regular telephones such as VoIP desk phones, cell phones, etc. I did not testify that a "regular telephone" was limited to being an analog telephone.

32. On page 30 of Mr. Bress's report he again takes my testimony out of context in discussing "SSL Fax" and other means of communicating fax image data "over connections other than the PSTN". I was clear in my testimony that in all such cases the fax communication is always initiated by a regular telephone call over the PSTN, and that during the subsequent T.30 fax protocol the devices may choose to offload some or all of the remaining communication to other connections. In all cases the equipment always had the capacity to perform the fax operation on the regular telephone line where the fax call was initiated.

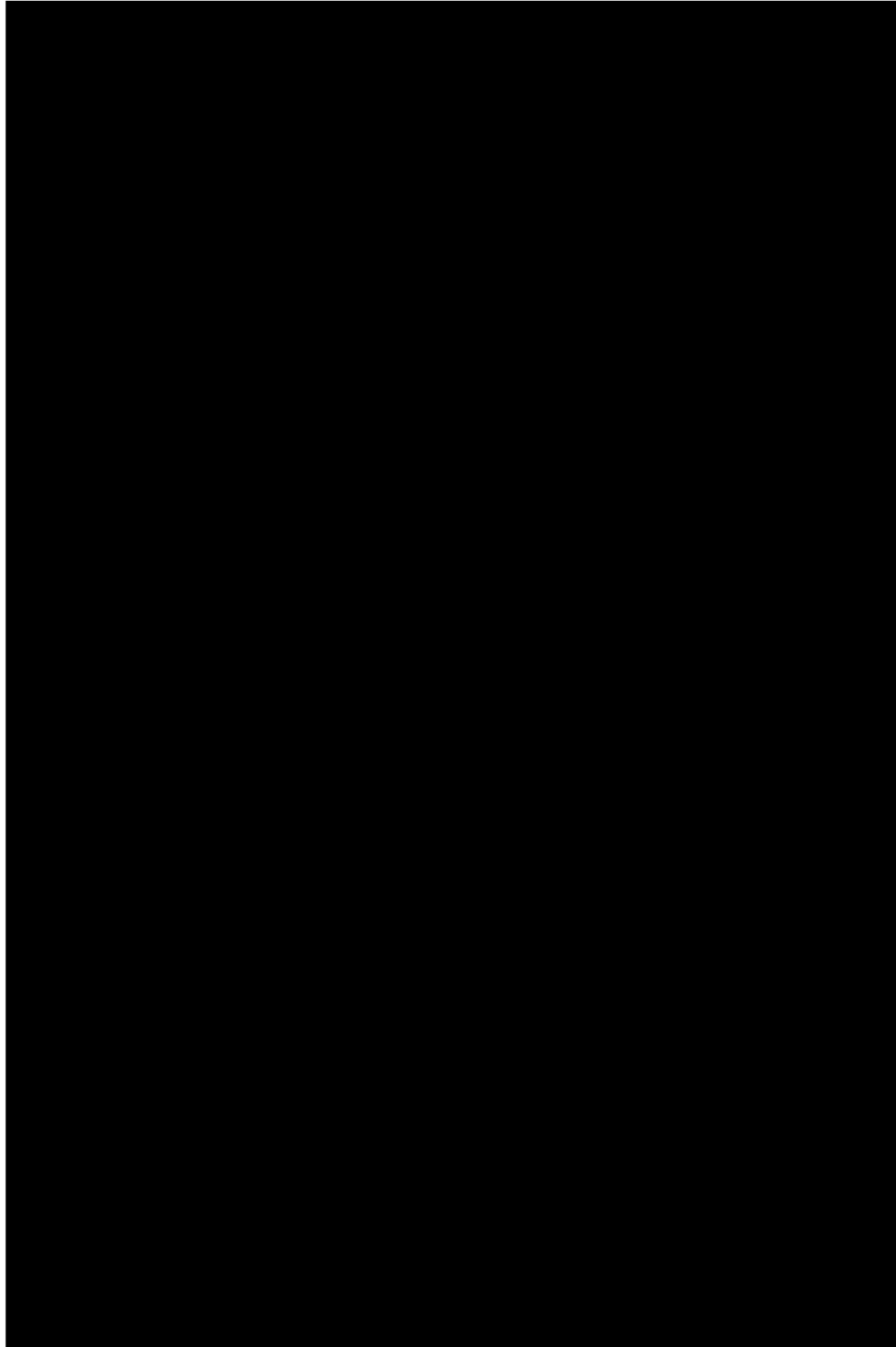
33. Mr. Bress raises issues about headers on Dr. Fulton's faxes which seem to reflect misunderstandings on his part. The TCPA states under "Technical and procedural

standards” that “it shall be unlawful for any person within the United States... to use a computer or other electronic device to send any message via a telephone facsimile machine unless such person clearly marks, in a margin at the top or bottom of each transmitted page of the message or on the first page of the transmission, the date and time it is sent and an identification of the business, other entity, or individual sending the message and the telephone number of the sending machine or of such business, other entity, or individual.”

34. For this reason most standalone fax machines, fax software, and fax servers will add a “header” (sometimes also known as a “tagline” or “timestamp”) to each page of the fax document they send. Usually the devices allow the user or administrator to configure somewhat the actual content of the header, and for this reason they may sometimes omit some required information.

35. There are a variety of methods by which sending fax machines may add the header to the transmitted document image. Some devices will overwrite a portion of the existing page image data with the header; some devices will resize the page image to fit the header; and some devices will increase the image size in order to add the header. Fonts and content can vary based on configuration and equipment type.

36. As a demonstration of this, I now provide samples of the Sfax-Enclarity headers found on the "Received Faxes.pdf" document I reviewed in preparation for my initial report:





37. That all of these header samples use the same format and font and that these samples can reliably be believed to have been received on different types and configurations of fax equipment and that these samples were all sent by the same sender illustrates that the fax header is placed into the image by the fax sender and not by the fax receiver.

38. Some fax devices do provide a configuration whereby received faxes are additionally marked in some fashion. However, this is not required by the TCPA, and this configuration is usually not enabled as a default setting. Mr. Bress notes in his report that although the HP LaserJet Pro 400 MFP has such a feature it is not enabled by default.

39. On pages 37 through 40 of his report Mr. Bress presents the various fax image headers found on the faxes received by Dr. Fulton. Confusingly, Mr. Bress describes the variations in the format and style of the various fax image headers included by the fax sender as “discrepanies”.

40. Mr. Bress appears to have taken testimony by Dr. Fulton following the question, “Do you know what, if anything, get stamped on faxes that you receive?” and somehow confused this with his knowledge of the feature available on the HP fax machine mentioned above to mark received faxes. Dr. Fulton did not testify that his HP fax machine was configured to mark received faxes. Dr. Fulton testified that he did not configure his HP fax machine. Dr. Fulton merely indicated that he believed that the faxes which he received were marked with the date and time that he received the fax. He did not state that he knew whether that marking was coming from the sender’s device or his own device.

41. The statement in the HP LaserJet Pro 400 MFP manual saying “the product prints the sender identification information at the top of each received fax” is merely a statement that the device will print the header that was provided in the fax image by the sender. It appears that the statement is made to emphasize to the reader that the indicated feature provides an additional marking that may be enabled, if desired. Although the statement is less clear than I feel it could have been written, the statement does not mean that the normal fax header information is or even can be accurately constructed by the receiving fax device.

42. Mr. Bress is, therefore, incorrect in his conclusion that all faxes received by Dr. Fulton’s fax machine should bear headers that use the same font and should be

formatted the same. All of the faxes received by Dr. Fulton's fax machine bear the headers as put there and formatted by the sender. Therefore, I would not expect that the header format and font for FULTON 0001 would necessarily appear on any other faxes received by Dr. Fulton, except perhaps, if they were also sent by Sfax or Enclarity.

43. To the extent that Dr. Fulton may have been led by the deposition questioning to believe that the fax header stamp was constructed by his own fax machine and placed into the image by his machine as the fax was received, it seems unreasonable of Mr. Bress to burden Dr. Fulton to be an expert on how fax machines operate as Dr. Fulton never expressed any claim that he was such. It seems that Mr. Bress, himself, misunderstands how the headers on fax image pages are generated, and as Mr. Bress is employed in telecommunications, I would not expect that Dr. Fulton would necessarily know more about this than Mr. Bress would, himself.

44. In the report by Bruce Deal he states, "Mr. Howard has not provided a reliable method for identifying members of a class", and "Mr. Howard's analysis appears to be an attempt to isolate fax deliveries occurring prior to communication from HCPs". In these statements Mr. Deal seems to be impugning opinions to me which are not in my report and which I explained in my deposition. I do not have an opinion or assumption as to who should or should not be members of any class, nor have I relied on such opinions or assumptions. I produced Exhibits A and B in my initial report following instructions

given to me by counsel. Those exhibits were the result of me analyzing data based on parameters requested by counsel.

45. On page 14 of Mr. Deal's report he suggests that [REDACTED] in the Phone Call Data could be used to identify another potential date of communication by a health care provider with Enclarity. Counsel requested that I produce a list to contain summaries from "Transmission Data" for each distinct fax number where a date expressed in the [REDACTED] column preceded any date expressed in [REDACTED] for any record associated with that fax number and also preceded any date expressed in [REDACTED] from "Phone Call Data" for any record associated with that fax number (collectively identified as "first_response_date"). I have provided this list as a Microsoft Excel spreadsheet with this report as "Exhibit A.1 (Modified)" along with sample pages in PDF copy in Appendix 5. Exhibit A.1 (Modified) contains [REDACTED] distinct fax numbers containing a total of [REDACTED] in the "deliveries" column and [REDACTED] in the "deliveries_adjusted" column. This compares to the counts in Exhibit A of my previous report with [REDACTED] distinct fax numbers containing a total of [REDACTED] in the "deliveries" column and [REDACTED] in the "deliveries_adjusted" column. So, the use of [REDACTED] as suggested by Mr. Deal results in [REDACTED] fewer distinct fax numbers, [REDACTED] fewer in "deliveries", and [REDACTED] fewer in "deliveries_adjusted".

46. [REDACTED]

However, such documented information has not been provided to me for producing Exhibits in this matter. If additional relevant records do exist then I could potentially utilize them to adjust or modify the results found in the Exhibits. However, I am not aware that such documentation has been produced in this case.

47. Counsel has requested that I produce an additional list using the same parameters as Exhibit B in my initial report, but this time group the results by distinct combinations of fax number, name, address, and phone number instead of only by distinct fax numbers. I have produced this list as a Microsoft Excel spreadsheet with this report as "Exhibit B.1" along with sample pages in PDF copy in Appendix 6. As did Exhibit B in my initial report, this set of data contains [REDACTED] distinct fax numbers containing a total of [REDACTED] in the "deliveries" column. In Exhibit B.1 there are [REDACTED] distinct combinations of fax number, name, address, and phone number.

48. Counsel has also requested that I produce an additional list using the same parameters as Exhibit A.1, above, except that also I summarize based on fax, name, address, and phone combinations rather than only on fax, and that I exclude Transmission Data records (rows) from the “deliveries” and “deliveries_adjusted” sums for which there is a recorded [REDACTED] value in that record. I have have produced this list provided as a Microsoft Excel spreadsheet with this report as “Exhibit C” along with sample pages in PDF copy in Appendix 7. Exhibit C contains [REDACTED] records of distinct combinations of fax, name, address and phone data. Exhibit C contains [REDACTED] distinct fax numbers containing a total of [REDACTED] in the “deliveries” column and [REDACTED] in the “deliveries_adjusted” column. Comparing these to Exhibit A.1 (Modified), above results in [REDACTED] fewer distinct fax numbers, [REDACTED] fewer in “deliveries”, and [REDACTED] fewer in “deliveries_adjusted”.

49. All opinions set forth in this report are based upon a reasonable degree of professional certainty.

Dated: December 21, 2021

By: /s/ [REDACTED]



Appendix 1

[Log In](#)

Analog Line

Overview

Analog lines are often referred to as Plain Old Telephone Service (POTS) lines and provide a single analog communications circuit between the local end office (Class 5 switch) and the customer's telephone, key system, fax machine or modem. The analog line offers a reliable solution for routine business telecommunications applications.

Benefits

- **Feature-rich & Flexible.** Verizon offers an impressive array of local features that define and enhance its business line offering:
 - Caller ID
 - Call waiting
 - Speed dialing
 - Conference call (three-way calling)
- **No oversubscription available.** Analog lines are comprised of one phone number per line (1:1 ratio).
- **Practical.** A large government office may provision business lines to use as a disaster recovery back up to a local PBX solution.
- **Customer Service.** Verizon is the single point of contact.

Features

Verizon supports two-wire analog lines with loop signaling at 4000 Hz bandwidth per the specifications in Telcordia Pub SR-TSV-002275, Section 13.2.2.

- Connects homes/businesses over copper wires (copper wires wound around each other are called "twisted pair").
- Traditionally used for voice communications using an analog signal.

[WITS 3 resources](#)[WITS 3 Customer Service Center](#)[1-800-381-3444](#)[Service@once Portal](#)[Access Pricing Tool](#)[Contact Account Rep](#)

WITS 3 Analog Lines | Verizon

<https://www.verizon.com/business/solutions/publi...>

- Support data by utilizing a modem at a maximum rate of 56 Kbps.
- Typically provisioned with "loop start signaling".

WITS 3 Analog Lines | Verizon

<https://www.verizon.com/business/solutions/publi...>

Products, Solutions & Deals	About Verizon	Manage My Account Online	Contact Us
Products	About Us	Sign In/Manage My Account	Contact Us
Plans	Our Company	About My Business	Request a Call
Solutions	Corporate Responsibility		Request a Store Appointment
Verizon Business Deals	Verizon Foundation		Contact Wireless Support
Wireless Devices	Careers	Follow	Fios Order Status
Why Verizon	News		Contact FiOS, Internet and Phone Service Support
	Investors		Contact Enterprise Support
	Site Map		Find a Verizon Store

WITS 3 Analog Lines | Verizon

<https://www.verizon.com/business/solutions/publi...>**Programs**

Wholesale

Partner Program

For Property
ManagersDevice Trade-in
ProgramWireless Return
PolicyExecutive
Briefing Program

Refer a Business

ResourcesBusiness
Resources &
InsightsReport a Security
VulnerabilityWEA
Compatibility

Service Guide

Customer
Enablement
Tools

Recall

**Quick Tasks for
Enterprise**Add to Your
Services

Change a Service

Create a Billing
InquiryCreate a Repair
TicketDisconnect a
Service

Move a Service

Check Billing
Inquiry StatusCheck Repair
Ticket Status

Cookies Settings

SubscribeSign up for
wireless updatesSign up for
Enterprise and
Medium business
updates



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Open Internet

Analytics

Appendix 2



AT&T Gives Business 'Plain-Old' Phone Service a Cloud Makeover

AT&T Phone for Business-Advanced digitizes analog phone service for voice and data lines

DALLAS, October 1, 2021

What's the news? AT&T is modernizing business' traditional analog phone lines using the cloud. AT&T Phone for Business-Advanced is designed to breathe new life into 'plain-old-telephone-service' (POTS) by pairing the reliability of POTS with the voice quality, security and lower maintenance costs of digital lines using market leading cloud capabilities with RingCentral. The new service is available now to nearly any business in the U.S.

Why is this important? Many businesses across the U.S. still use traditional wireline phone service not just for standard voice capabilities, but also for specialty functions. Tens of millions of alarms, elevators, fax machines, modems, and point-of-sale terminals across the country depend on these lines for voice and/or smaller-scale data transfers. For example, healthcare providers use these lines for potentially lifesaving communications and equipment. In many of these cases, reliability is paramount.

Using an enterprise-grade appliance by DataRemote® that converts analog traffic so that it can be transferred over a VoIP Managed Facility Voice Network (MFVN), providing that traffic with inherent enhancements in security using infrastructure that is easier and less expensive to maintain with built in failover options.

The new service will give users an easy way to maintain business continuity and monitor connections to help ensure they are working properly before an issue arises. Data Monitoring Centers help monitor and maintain highly secure connectivity and can keep phone lines running for 24/7 using the AT&T Wireless network. Additionally, in case of local power failure, the device can provide 12 hours of operation using an internal battery backup.

For businesses with locations across the country, this could help simplify billing as analog phone and data rates and regulations vary by state. Businesses using AT&T Phone for Business-Advanced can standardize rates and consolidate all lines into one simple bill—nationwide.

What are people saying?

"Tried and true. Until now, traditional wireline phone service has been hard to beat for specialty data and voice lines. With AT&T Phone for Business-Advanced, we've found a way to modernize these lines to introduce customers to new cloud capabilities while maintaining the reliability and regulatory compliance that they require." – **Rich Shaw, Vice President, Voice and Collaboration, AT&T Business**

"We are excited to launch a new offering with AT&T and DataRemote to the millions of customers with traditional phone services including specialty lines. RingCentral believes enterprises today



are looking for trusted relationships and joint innovation to deliver the most seamless journey to the cloud across every use case.” – **Sandra Krief, VP Service Providers, Americas, RingCentral**

Where can I find more information? Please visit [here](#) for more information.

***About AT&T Communications**

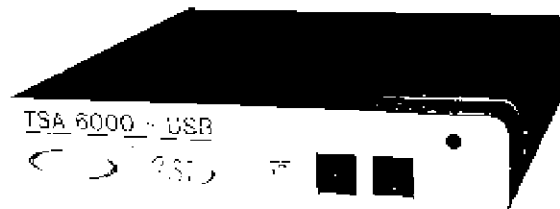
We help family, friends and neighbors connect in meaningful ways every day. From the first phone call 140+ years ago to mobile video streaming, we @ATT innovate to improve lives. AT&T Communications is part of AT&T Inc. (NYSE:T). For more information, please visit us at [att.com](#).

Appendix 3

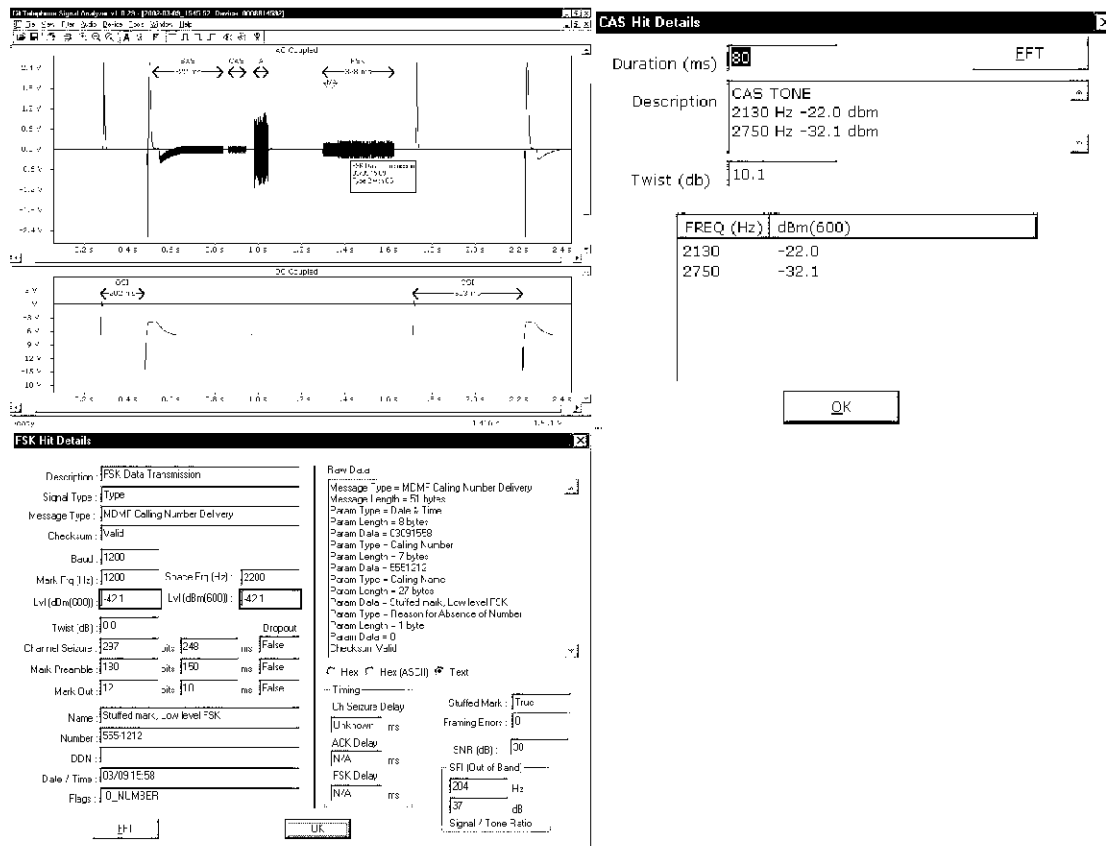
TSA 6000® - AST Technology Labs

<http://www.asttechlabs.com/testproducts.cfm>

Home (/) > TSA 6000®



TSA 6000®



The TSA 6000® is a USB device that provides complete analysis of analog port telephone signals including Caller-ID protocols, FXS/FXO interface testing, DTMF, power ringing, single frequency interference noise, call progress tones, noise and more. The TSA 6000® is FCC, CSA C/US and CE approved.

This product can be easily used by all field and lab personnel.

Please visit www.TSA6000.com (<http://www.TSA6000.com>).

Email **tsa6000@asttechlabs.com** to request a quotation or for more information.

FOR USE IN:

- VoIP and Set top box terminal adaptors testing

- FXS and FXO port testing
- Telephone Line and Caller-ID Signaling Verification
- Telephone Line and Caller-ID Troubleshooting
- Central Office Signaling Analysis
- Digital Loop Carrier (DLC) Signaling Verification (GR-57)
- Customer Premises Equipment Troubleshooting
- Network Equipment Installation Verification
- ILEC / CLEC Signal Interface Troubleshooting
- Caller ID Loop Surveys
- Wireline SMS (ETSI ETS 100 900, ETSI ETS 100 901)
- ADSI Protocol Verification (SR-1273, SR-2461)
- Russian ANI (Russian Caller ID) Verification
- ADEMCO Alarm Protocol Verification
- Plus many other uses

HOME

Home (/)
 TSA 6000 ®
 (/testproducts.cfm)
 Contact Us (/contact-us.cfm)

SERVICES

Microsoft Teams
 Device Certification
 Program (/services/
 /microsoft-teams-
 device-certification-
 program-9.cfm)
 Zoom Headset Device
 Certification Program
 (/services/zoom-
 headset-device-
 certification-program-
 17.cfm)
 Amazon Alexa
 Certification Test
 Services (/services/
 /amazon-alexa-
 certification-test-
 services-14.cfm)
 FCC/ISED Hearing Aid
 Compatibility (HAC)
 Magnetic and Volume
 Control (/services/fcc-
 ised-hearing-aid-
 compatibility-hac-
 magnetic-and-

ABOUT US

Overview (/about-us.cfm)
 Executive Team
 (/about-us/team.cfm)
 Standards
 Development (/about-us/standardsdevelopment.cfm)
 Labs and Facilities
 (/about-us/labsandfacilities.cfm)

volume-control-
15.cfm)
Analog Telephone
Devices (/services
/analog-telephone-
devices-2.cfm)
Digital
Communication
Devices (VoIP)
(/services/digital-
communication-
devices-voip-3.cfm)
Amplified Telephones
(ANSI/TIA-4953) (high
gain) (/services
/amplified-
telephones-ansi-
tia-4953-high-
gain-11.cfm)
Active Noise
Cancelling Testing
(ANC testing)
(/services/active-
noise-cancelling-
testing-anc-testing-
16.cfm)
Analog Terminal
Adaptors (ATA, FXS)
(/services/analog-
terminal-adaptors-
ata-fxs-5.cfm)
Gateways (FXO, VoIP)
(/services/gateways-
fxo-voip-4.cfm)
Set-Top Box (STB)
(/services/set-top-box-
stb-6.cfm)
PBX Communication
Systems (VoIP,
Analog, Proprietary)
(/services/pbx-
communication-
systems-voip-analog-
proprietary-7.cfm)
Bluetooth® Devices

TSA 6000® - AST Technology Labs

<http://www.asttechlabs.com/testproducts.cfm>

(/services/bluetooth-
devices-10.cfm)
Acoustic Shock
(/services/acoustic-
shock-12.cfm)
Component
Engineering (/services
/component-
engineering-13.cfm)
International
Standards (/services
/international-
standards-8.cfm)
VoIP Devices and
Systems (/services
/voip-devices-and-
systems-1.cfm)

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Appendix 4

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UNITED STATES

SECURITIES AND EXCHANGE COMMISSION
WASHINGTON, D.C. 20549

FORM 10-K

(Mark one)

(X) ANNUAL REPORT PURSUANT TO SECTION 13 OR 15 (d) OF THE SECURITIES
EXCHANGE ACT OF 1934

For the fiscal year ended: September 30, 1999

OR

() TRANSITION REPORT PURSUANT TO SECTION 13 OR 15 (d) OF THE SECURITIES
EXCHANGE ACT OF 1934

For the transition period from ____ to ____.

Commission file number: 0-17972

DIGI INTERNATIONAL INC.
(Exact name of registrant as specified in its charter)

Delaware	41-1532464
(State or other jurisdiction of incorporation or organization)	(I.R.S. Employer Identification Number)

11001 Bren Road East
Minnetonka, Minnesota 55343
(Address of principal executive offices) (Zip Code)

(612) 912-3444
(Registrant's telephone number, including area code)

Securities registered pursuant to Section 12(b) of the Act: None

Securities registered pursuant to Section 12(g) of the Act:
COMMON STOCK, \$.01 PAR VALUE
(Title of each class)

Indicate by check mark whether the Registrant (1) has filed all reports required
to be filed by Section 13 or 15 (d) of the Securities Exchange Act of 1934
during the preceding 12 months, and (2) has been subject to such filing
requirements for the past 90 days.

Yes X No
--- ----

Indicate by check mark if disclosure of delinquent filers pursuant to Item 405
of Regulation S-K is not contained herein, and will not be contained, to the
best of Registrant's knowledge, in definitive proxy or information statements
incorporated by reference in Part III of this Form 10-K or any amendment to this
Form 10-K. []

The aggregate market value of voting stock held by nonaffiliates of the
Registrant, based on a closing price of \$10.94 per share as reported on the
National Association of Securities Dealers Automated Quotation System-National
Market System on December 17, 1999 was \$147,485,017.

Shares of common stock outstanding as of December 10, 1999: 15,008,190.

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DOCUMENTS INCORPORATED BY REFERENCE

The following table shows, except as otherwise noted, the location of
information required in this Form 10-K, in the Registrant's Annual Report to
Stockholders for the year ended September 30, 1999 and Proxy Statement for the
Registrant's Annual Meeting of Stockholders scheduled for January 26, 2000, a

definitive copy of which will be filed on or about December 31, 1999. All such information set forth below under the heading "Page/Reference" is incorporated herein by reference, or included in this Form 10-K on the pages indicated.

PART I.	ITEM IN FORM 10-K	PAGE/REFERENCE
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ITEM 6.	Selected Financial Data: Financial Highlights	Page 1, Annual Report to Stockholders
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PART III. -----	ITEM IN FORM 10-K -----	PAGE/REFERENCE -----
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PART I

ITEM 1. BUSINESS

Digi International Inc. ("Digi" or the "Company") was formed in 1985 as a Minnesota corporation and reorganized as a Delaware corporation in 1989 in conjunction with its initial public offering. The Company is a worldwide provider of communications adapters that enable open systems, server-based applications. In addition, the Company produces local area networking (LAN) products.

The Company operates exclusively in a single business segment and sells its products through a global network of distributors, systems integrators, value added resellers (VARs) and original equipment manufacturers (OEMs). The Company also sells direct to select accounts and the government.

Digi International Inc. is traded on the Nasdaq National Market under the symbol DGII. The Company has its worldwide headquarters in Minnetonka, Minnesota, with regional and sales offices throughout the U.S. and worldwide, including Germany, Paris, London, Amsterdam, Copenhagen, Singapore, Hong Kong, Sydney, and Tokyo.

PRODUCTS

Digi products enable a virtually unlimited number of users to be connected locally or remotely to a LAN, the Internet or to multi-user computer systems. The Company's products provide asynchronous and synchronous data transmissions for analog modems, ISDN (Integrated Services Digital Network), X.25, Frame Relay or T1/E1 connections. The application markets where these products are most prominently used are POS (Point-of-Sales Systems), Industrial Automation, routing, remote access, and network fax.

The Company's two primary communication adapter product lines are its DataFire digital and AccelePort multi-port serial communications adapters. These adapters integrate unique and powerful (Digital Signal Processing) DSP-based technology that allows them to support a broad array of communications functions simultaneously. It collaborates with partners to ensure that its boards are among the industry's most widely supported. This includes working closely with leading makers of PCs, workstations and other computer hardware, to offer the highest levels of compatibility. The Company also conforms to the standards necessary to enable built-in support for its products in many major operating systems, and writes its own drivers to expand that support where necessary. The Company also works closely with software application partners, to pre-test and certify their applications to run on Digi boards.

The Company's server-based communication adapter products constituted approximately 90%, 80% and 76% of net sales in fiscal 1999, 1998 and 1997, respectively.

The Company entered the LAN market with its acquisition of MiLAN Technology Corporation in November 1993. The Company's LAN business, formerly the MiLAN Technology Division, provides cost-effective and power-efficient Ethernet, Fast and Giga Ethernet networking connectivity products that are installed on a LAN to increase its productivity.

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ITEM 1. BUSINESS (CONTINUED)

SERVER-BASED COMMUNICATIONS AND THE MARKET

Server-based communications is based on a open systems where the PC server and operating system serve as standardized components. The components of a server-based communications solution include:

A computer hardware platform and operating system, such as a PC or RISC server running Windows NT, Novell NetWare, UNIX, LINUX or an IBM AS/400 midrange computer;

One or more communications adapters, like Digi's DataFire and AccelePort products;

Specialized communications application software, available from a wide range of companies.

Server-based communications solutions are a major growth area. As the middleware functions of operating systems are improved and enhanced, the Company believes this market will expand dramatically over the next few years. It has already begun to grow from something more suitable for small- to medium-sized businesses to technology with the reliability, performance and scalability to meet the needs of large enterprises. The Company believes that in the future, server-based solutions will continue to grow market share against proprietary boxes for remote access, network fax, and, computer telephony.

The Company believes that the key benefits for server-based solutions include low cost of ownership, increased flexibility and scalability, dependability, simplified training and support, and the ability for channel partners to add value and increase profits.

VOICE OVER INTERNET PROTOCOL

The Company entered the Internet telephony market with the acquisition of ITK International, Inc. ("ITK International" or "ITK") in July of 1998 and its Voice over Internet Protocol ("VoIP") technology. ITK provides VoIP technology with the NetBlazer 8500 gateway, a "proof of concept" product that converts voice signals to TCP/IP packets and routes them over IP networks such as the Internet and company Intranets. This capability combines voice and data onto one cost-effective network. Although the VoIP technology acquired from ITK continues to be under development, the Company believes that this technology will be successful once a functioning finished product is complete and can be marketed to "Carrier Class" telephone companies. The current version of the NetBlazer 8500, which includes a sub-set of its ultimate feature set, provided revenues of \$3.0 million during fiscal 1999; total fiscal 1999 net revenue for ITK was \$25.7 million. Digi acquired ITK International for approximately \$29.6 million in cash, stock, replacement stock options and the assumption of \$39.8 million of liabilities and restructuring/integration costs.

UNIVERSAL SERIAL BUS AND TERMINAL SERVER

The Company expanded its product lines with its acquisition of Central Data Corporation ("Central Data" or "CDC") in July 1998. The Company also acquired in-process research and development from Central Data related to Universal Serial Bus (USB) technology. This in-process technology will give customers the ability to maintain existing non-USB peripheral equipment and connect with new PCs, which contain advanced USB interfaces. The Company introduced USB products in fiscal 1999, which provided \$266,000 of net revenue; total net revenue contributed by CDC product lines during fiscal 1999 was \$16.9 million. The EtherLite product line, a family of terminal servers used in multiuser and communications applications, provided 70% of these net revenues. The Company acquired Central Data for approximately \$21.3 million in cash, stock, replacement stock options and the assumption of \$4.4 million of liabilities and restructuring/integration costs.

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ITEM 1. BUSINESS (CONTINUED)

DISTRIBUTION AND PARTNERSHIPS

The Company sells and markets its products through a global network of distributors, systems integrators, value added resellers (VARs) and original equipment manufacturers (OEMs). The Company also sells direct to select accounts and the government. Internationally, Digi sells and markets its products through 180 distributors in more than 65 countries. More than 300 VARs participate in the DigiVAR Program.

U.S. distributors include: Ameriques-/Robec, Access Graphics, Anixter, Avnet/Hallmark, Gates/Arrow Distributing, Graybar, Ingram Micro, Jones Business Systems, Kent, Merisel, Pinacor, Tech Data Corporation, Westcon and Savior Technologies. Canadian distributors include Gates/Arrow Electronics, EMJ Data Systems, Ingram Micro Canada, Merisel Canada and Tech Data Canada.

European distributors include Miel, Arecta, International Computer Products, Connect Service Riedlbauer, Mitrol, Euroline and Data Solutions. Latin American and Asia Pacific distributors include Tech Pacific, Sumisho Datacom, Lantech, Sealcorp Computer Products, Ingram Dicom and Unisel.

Digi maintains strategic partnerships with other industry leaders to develop and market technology solutions. These include most major communications software vendors, operating system suppliers and computer hardware manufacturers.

Key Company partners include: Citrix Systems, Compaq, Hewlett-Packard, IBM, Intel, Lotus, Micron, Microsoft, Motorola, Novell, Red Hat, Santa Cruz Operation (SCO), Sun Microsystems, and Fundacao CPqD (the Brazilian R&D Center for Telecommunications).

CUSTOMERS

The Company's customer base includes many of the world's largest companies. IBM made the Company's adapter boards the first integrated communications offering for the AS/400 in 1999. Red Hat has made the Company a development partner. The Company has OEM relationships with leading vendors, allowing them to ship the Company's boards with their systems. These vendors include NCR, Sun Microsystems, Silicon Graphics, AT&T, Siemens and many others. Many of the world's leading telecommunications companies and ISPs also rely on the Company's products.

During the year ended September 30, 1999, two customers comprised more than 10% of net sales each: Tech Data at 15.4% and Ingram Micro at 13.4%. During the year ended September 30, 1998, two customers comprised more than 10% of net sales each: Ingram Micro at 13.5% and Tech Data at 13.7%. During the year ended September 30, 1997, two customers comprised more than 10% of net sales each: Ingram Micro at 15.1%, and Tech Data at 10.5%.

COMPETITIVE CONDITIONS

The computer industry is characterized by rapid technological advances and evolving industry standards. The market can be significantly affected by new product introductions and marketing activities of industry participants. The Company competes for customers on the basis of product performance in relation to compatibility, support, quality and reliability, product development capabilities, price and availability. The Company believes that it is the market leader in serial port boards for server-based communications in the computer industry. With respect to the LAN business, the Company believes it commands less than a 5% market share. The Company is currently establishing its position in the remote access market for the Company's DSP-based RAS product lines. The Company will enter the Internet telephony market upon full development of its VoIP technology.

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ITEM 1. BUSINESS (CONTINUED)

Many of the Company's competitors and potential competitors have greater financial, technological, manufacturing, marketing and personnel resources than the Company. Present and future competitors may be able to identify new markets and develop products more quickly and which are superior to those developed by the Company. They may also adapt new technologies faster, devote greater resources to research and development, promote products more aggressively and price products more competitively than the Company. There are no assurances that competition will not intensify or that the Company will be able to compete effectively in the markets in which the Company competes.

The major competition for open system server-based communications solutions offered by the Company are proprietary boxes from companies like Cisco, Ascend, 3Com, Shiva and others. Today, these proprietary boxes represent the majority of the market for networked communications solutions.

AETHERWORKS CORPORATION

In May 1998, the Company exchanged its previously purchased \$13,796,525 of convertible notes from AetherWorks Corporation, a development stage company engaged in the development of wireless and dial-up remote access technology, for a non-interest bearing \$8,000,000 non-convertible note. As a part of the exchange, the Company relinquished its rights to any future technology or claims on any of AetherWorks' intellectual properties. In exchange, the Company has been released from all of its guarantees of certain lease obligations of AetherWorks.

OPERATIONS

The Company's manufacturing operations procure all parts and certain services involved in the production of products and subcontracts most of its product manufacturing to outside firms that specialize in such services. The Company believes that this approach is beneficial because the Company can reduce its fixed costs, maintain production flexibility and maximize its profit margins.

The Company's products are manufactured to its designs with standard and semi-custom components. Most of these components are available from multiple vendors. The Company does have several single-sourced supplier relationships, either because alternative sources are not available or because the relationship is advantageous to the Company. If these suppliers are unable to provide timely and reliable supply of components, the Company could experience manufacturing delays adversely affecting its results of operations.

During fiscal years 1997, 1998 and 1999, the Company's research and development expenditures were \$18.0, \$17.0, and \$24.7 million, respectively.

Due to rapidly changing technology in the computer industry, the Company believes that its success depends primarily upon the engineering, marketing, manufacturing and support skills of its personnel, rather than upon patent protection. Although the Company may seek patents where appropriate and has certain patent applications pending for proprietary technology, the Company's proprietary technology or products are generally not patented. The Company relies primarily on the copyright, trademark and trade secret laws to protect its proprietary rights in its products. The Company has established common law and registered trademark rights on a family of marks for a number of its products.

As of September 30, 1999, the Company had backlog orders which management believed to be firm in the amount of \$5.9 million. All of these orders are expected to be filled in the current fiscal year. Backlog as of September 30, 1998 was \$2.9 million.

Total employees at September 30, 1999 were 583.

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ITEM 2. PROPERTIES

The Company's headquarters and research facilities are located in a 130,000 square foot office building in Minnetonka, Minnesota which the Company acquired in August 1995 and has occupied since March 1996. The Company's primary manufacturing facility is located in a 58,000 square foot building in Eden Prairie, Minnesota, which the Company purchased in May 1993 and has occupied since August 1993. Additional office and research facilities include a 63,000 square foot facility in Dortmund, Germany, a 46,170 square foot facility in Sunnyvale, California, the lease for which expires in April 2002, and a 5,000 square foot facility in Champaign, Illinois, the lease for which expires in January 2002.

Management believes that the Company's facilities are suitable and adequate for current office, research and warehouse requirements, and that its manufacturing facilities provide sufficient production capacity to meet the Company's currently anticipated needs.

ITEM 3. LEGAL PROCEEDINGS

Between January 3, 1997 and March 7, 1997, the Company and certain of its previous officers were named as defendants in putative securities class action lawsuits filed in the United States District Court for the District of Minnesota by 21 lead plaintiffs on behalf of an alleged class of purchasers of the Company's common stock during the period January 25, 1996 through December 23, 1996. The putative class actions were thereafter consolidated (Master File No. 97-5 LWF/RLE). The Consolidated Amended Class Action Complaint ("Consolidated Amended Complaint") alleges that the Company and certain of its previous officers violated the federal securities laws by, among other things, misrepresenting and/or omitting material information concerning the Company's operations and financial results.

On February 25, 1997, the Company and certain of its previous officers also were named as defendants in a securities lawsuit filed in the United States District Court for the District of Minnesota by the Louisiana State Employees Retirement

System (Civil File No. 97-440, Master File No. 97-5 DWF/RLE) (the "Louisiana Amended Complaint"). The Louisiana Amended Complaint alleges that the Company and certain of its previous officers violated the federal securities laws and state common law by, among other things, misrepresenting and/or omitting material information concerning the Company's operations and financial results.

In a decision issued on May 22, 1998, the Court dismissed without leave to replead all claims asserted in both cases, except for certain federal securities law claims based upon alleged misrepresentations and/or omissions relating to the accounting treatment applied to the Company's AetherWorks investment. The Court also limited the claims asserted in the Louisiana Amended Complaint to the 11,000 shares of the Company's stock held subsequent to November 14, 1996, for which the Louisiana Amended Complaint claims damages of \$184,276.40 and seeks an award of attorneys' fees, disbursements and costs. The Consolidated Amended Complaint seeks compensatory damages of approximately \$43.1 million plus interest against all defendants, jointly and severally, and an award of attorneys' fees, experts' fees and costs. The claims in the two actions remain pending against the Company and its former officers Ervin F. Kamm, Jr. and Gerald A. Wall.

The 21 lead plaintiffs have moved for class certification with respect to the claims asserted in the Consolidated Amended Complaint. The Company and its former officers intend to oppose the motion. No date has been set for a hearing on the class certification motion. With the possible exception of additional depositions of certain lead plaintiffs, discovery in all of the actions has been completed.

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ITEM 3. LEGAL PROCEEDINGS (CONTINUED)

The Company and its former officers served motions for summary judgment in all actions on November 19, 1999. Briefing on the motions is scheduled to be completed by February 4, 2000, and a hearing is expected to be held before the Court after that date.

The ultimate outcomes of these actions cannot be determined at this time, and no potential assessment of their effect, if any, on the Company's financial position, liquidity or future operations can be made.

ITEM 4. SUBMISSION OF MATTERS TO A VOTE OF SECURITY HOLDERS

There were no matters submitted to the vote of security holders during the quarter ended September 30, 1999.

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PART II

ITEM 6. SELECTED FINANCIAL DATA

	1999	1998 (% restated (1))	1997	1996	1995
Net sales	\$ 193,506	\$ 182,932	\$ 165,198	\$ 193,101	\$ 164,978
Percentage increase (decrease)	5.8%	10.5%	(14.3)%	17.1%	26.0%
Net income (loss)	3,190	(71)	(15,781)	9,300	19,331
Percentage increase (decrease)	2,789.5%	99.6%	(269.8)%	(51.9)%	15.7%
Net income (loss) per share-basic	0.22	(0.01)	(1.18)	0.70	1.42
Percentage increase (decrease)	2,300.0%	99.2%	(268.6)%	(50.7)%	(21.4)%
Net income (loss) per share-- assuming dilution	0.22	(0.01)	(1.18)	0.68	1.39
Percentage increase (decrease)	2,300.0%	99.2%	(268.6)%	(51.1)%	19.8%
Total assets	176,330	191,521	118,311	129,939	126,043
Percentage (decrease) increase	(7.4)%	61.9%	(8.6)%	3.1%	22.7%
Long-term debt	9,206	11,124			
Percentage (decrease)	(11.2)%				

Stockholders' equity	127,164	127,251	95,471	109,943	105,827
Percentage increase (decrease)	4.9%	27.0%	(13.2)%	3.9%	16.1%

(IN THOUSANDS EXCEPT PER SHARE AMOUNTS AND PERCENTAGES)

(1) See Note 2 to the Company's consolidated financial statements

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ITEM 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS

SAFE HARBOR STATEMENT UNDER THE PRIVATE SECURITIES LITIGATION REFORM ACT OF 1995

This Annual Report contains certain statements that are "forward-looking statements" as that term is defined under the Private Securities Litigation Reform Act of 1995, and within the meaning of Section 27A of the Securities Act of 1933, as amended, and Section 21E of the Securities Exchange Act of 1934, as amended. The words "believe," "expect," "anticipate," "intend," "estimate," "target," "may," "will," "plan," "project," "should," "continue," or the negative thereof or other expressions, which are predictions of or indicate future events and trends and which do not relate to historical matters, identify forward-looking statements. Such statements are based on information available to management as of the time of such statements and relate to, among other things, expectations of the business environment in which the Company operates, projections of future performance, perceived opportunities in the market and statements regarding the Company's mission and vision. Forward-looking statements involve known and unknown risks, uncertainties and other factors, which may cause the actual results, performance or achievements of the Company to differ materially from anticipated future results, performance or achievements expressed or implied by such forward-looking statements. The Company undertakes no obligation to publicly update or revise any forward-looking statement, whether as a result of new information, future events or otherwise.

The future operating results and performance trends of the Company may be affected by a number of factors, including, without limitation, the following: (i) the highly competitive market in which the Company operates; (ii) the Company's ability to respond to rapidly developing changes in its marketplace; (iii) delays in the Company's product development efforts; (iv) the useful life of products once developed; (v) the Company's ability to integrate its recent acquisitions and to develop marketable products from the acquired in-process research and development; (vi) the Company's reliance on distributors; (vii) declining prices of networking products; (viii) uncertainty in consumer acceptance of the Company's products; and (ix) changes in the company's level of revenue or profitability. These and other risks, uncertainties and assumptions identified from time to time in the Company's filings with the Securities Exchange Commission, including without limitation, its annual report on Form 10-K and its quarterly report on Form 10-Q, could cause the Company's actual future results to differ materially from those projected in the forward-looking statements as a result of the factors set forth in the Company's various filings with the Securities and Exchange Commission and of changes in general economic conditions, changes in interest rates and/or exchange rates and changes in the assumptions used in making such forward-looking statements.

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ITEM 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS (CONTINUED)

The following table sets forth selected information from the Company's Consolidated Statements of Operations, expressed as a percentage of net sales.

	1999	1998 (1)	1997	1999 over 1998	1998 over 1997
	-----	-----	-----	-----	-----

Net sales	100.0 %	100.0 %	100.0 %	5.8 %	10.5 %
Cost of sales	49.3	48.4	51.6	7.7	3.6
Gross margin	50.7	51.6	48.4	4.0	17.8
Operating expenses:					
Sales and marketing	21.2	20.4	22.1	10.0	1.1
Research and development	12.8	9.3	10.9	45.5	(5.6)
General and administrative	12.2	9.3	11.7	39.1	(12.0)
Acquired in-process research and development	-	8.8	-	(100.0)	-
Restructuring	0.3	0.5	8.3	(40.5)	(90.3)
	46.5	48.3	51.0	1.8	4.6
Operating income (loss)	4.2	3.3	(2.6)	36.2	239.6
Other (expense) income, net	(0.1)	1.0	0.1	(114.1)	1,082.2
AetherWorks Corporation net operating loss	-	-	(3.5)	-	(100.0)
AetherWorks Corporation gain (write-off)	-	0.7	(3.5)	(100.0)	(123.4)
Income (loss) before income taxes	4.1	5.0	(9.5)	(13.4)	158.7
Provision for income taxes	2.5	5.0	0.1	(48.1)	10,031.0
Net income (loss)	1.6 %	0.0 %	(9.6) %	4,589.5 %	(99.6) %

(1) See Note 2 to the Company's consolidated financial statements

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ITEM 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS (CONTINUED)

RESTATEMENT

The Company revised the accounting treatment of its July 1998 acquisitions of ITK and CDC in response to comments received from the Securities and Exchange Commission. On August 16, 1999, the Company filed Amendment No. 1 to the Registrant's 1998 Annual Report on Form 10-K filed with the Securities and Exchange Commission for the purpose of restating its financial statements for the year ended September 30, 1998.

NET SALES

The \$10.6 million or 5.8% increase in net sales from 1998 to 1999 and the \$17.3 million or 10.4% increase in net sales from 1997 to 1998 occurred within the Company's principal product groups as follows:

	Percent of Annual Net Sales			Annual Sales	
	1999	1998	1997	Increase 1999	(Decrease) 1998
Server Based	89.8%	79.8%	75.7%	18.9%	16.6%
Physical Layer	10.2%	20.1%	23.9%	(46.2)%	(6.9)%
Other	0.0%	0.0%	0.4%	0.0%	(100.0)%

Sales of ISDN and VoIP products added in connection with the July 1998 acquisition of ITK and USB and Etherlite products added in connection with the July 1998 acquisitions of CDC generated \$42.5 million of net sales for the 1999 fiscal year, an increase of \$32.8 over the net sales recognized during of the year ago period, which included ITK and CDC revenue in the fourth quarter of the fiscal year. These revenue increases were mitigated by a revenue decrease of \$13.3 million for the Company's legacy asynchronous products due to shrinking of the overall market and a shift in demand to digital technology products. The Company also experienced a decrease in demand for the Company's physical layer products due to a decrease in prices and competition resulting in a decrease in

revenues of \$17.0 million. Net sales of the Company's new DSP RAS products were \$8.7 million for the 1999 fiscal year, adding \$8.1 million over total DSP RAS product revenue in fiscal 1998. Net sales in fiscal 1998 increased from fiscal 1997 largely because the Company reduced inventory levels in the North American distribution channel throughout 1997 and into the first quarter of fiscal 1998. This resulted in a net increase in sales within the distribution channel during the remainder of 1998.

Net sales to original equipment manufacturers (OEMs) increased 18.6% over 1998 and as a percentage of total net sales, increased to 24.9% versus 22.2% in 1998. The increase was principally a function of sales added by ITK. Net sales to OEMs for 1997 were 23.5% of total sales.

Net sales into the distribution channel increased 5.9% over 1998 and as a percentage of total net sales, remained unchanged at 69.3% in 1999, compared to 1998. International distribution net sales increased by 31.4% over fiscal 1998 primarily due to new product revenues and the expanded distribution channel added by ITK. Domestic distribution net sales declined by 6.6% due to a decrease in inventory levels in the distribution channel. Net sales to the distribution market for 1997 represented 64.1% of total net sales.

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ITEM 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS (CONTINUED)

NET SALES (CONTINUED)

During fiscal years 1999, 1998 and 1997, the Company's net sales to customers outside the United States, primarily in Europe, were approximately \$67.4 million, \$46.7 million and \$44.5 million, respectively, comprising approximately 34.8%, 25.5% and 26.9% of total net sales.

GROSS MARGIN

Gross margin in 1999 decreased to 50.7%, compared to 51.6% in 1998, primarily due to the negative impact of sales of lower gross margin ITK products, an increased percentage of lower margin OEM sales, market-driven erosion of gross margin on physical layer products, and increases in the Company's inventory valuation reserves. Gross margin in the fourth quarter of fiscal 1999 improved to 54.0% when compared to gross margin of 52.0% in the fourth quarter of fiscal 1998, primarily due to improved operating efficiencies in the Company's production facilities.

Gross margin in 1998 rose to 51.6% compared to 48.4% in 1997 due to cost control measures and favorable product sales mix. Gross margin also benefited as net sales of historically lower-margin OEM and physical layer products declined as a percentage of total net sales. Offsetting the favorable sales mix were increases in inventory valuation reserves, sales discounts granted, and a higher proportion of lower margin products sold in the fourth quarter of fiscal 1998 due to the acquisition of CDC and ITK.

OPERATING EXPENSES

Excluding acquired in-process research and development charges of \$16,064,933 recorded in 1998, operating expenses in 1999 increased 24.5% from 1998. Sales and marketing expenses increased by \$3.7 million due to \$5.6 million of expenses added by ITK and CDC, \$1.8 million expended to promote new DSP RAS products, and a \$3.7 million cost decline primarily due to reduced North American channel marketing efforts. Research and development expenses increased \$7.7 million due to \$4.1 million of additional costs added by ITK and CDC with the remaining increase of \$3.6 million due to new product development costs for the DSP RAS products. General and administrative expenses increased by \$6.6 million primarily due to increased amortization of acquisition-related goodwill and other identifiable intangibles of \$8.0 million offset by \$1.4 million of cost reductions related reduced information systems implementation costs and other cost-saving initiatives.

Operating expenses in 1998 declined 3.7% from 1997, excluding acquired in-process research and development charges of \$16,064,933 recorded in 1998 and the restructuring charges recorded in 1998 and 1997 of \$1,020,000 and \$10,471,482 respectively. The operating expense decline reflected reductions in the workforce, decreased marketing costs and cost savings achieved through the

consolidation of U.S. research and development efforts, offset by CDC and ITK operating expenses of \$3.8 million. General and administrative expenses declined in 1998 due to workforce reductions and cost-saving initiatives, offset by increased intangible asset amortization.

The \$1.2 million of net restructuring charges recorded in fiscal 1999 were associated with the board approved plan to reorganize the sales and marketing functions in Germany, England and the United States, by consolidating worldwide sales and marketing resources into strategic locations. The charges

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ITEM 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS (CONTINUED)

OPERATING EXPENSES (CONTINUED)

consist principally of existing commitments for rent on facilities vacated by the Company and termination payments associated with the elimination of 42 positions. These activities are expected to be completed by December 1999. The Company anticipates annual cost savings of \$1.3 million from these restructurings. (See Note 4 to the Company's consolidated financial statements).

The \$1,020,000 restructuring charge recorded in the fiscal 1998 fourth quarter was associated with a board-approved plan to consolidate existing offices in Germany with those acquired from ITK. The charge consists principally of rent, contractual payments on office equipment, write-offs of leasehold improvements and termination costs associated with the elimination of six positions. Activities were completed by June 30, 1999. After change in estimate adjustments of \$572,000, the net charge of \$448,000 is anticipated to yield annual cost savings of \$425,000. (See Note 4 to the Company's consolidated financial statements).

The \$10,471,482 restructuring charge recorded in the fiscal 1997 second quarter was related to a board-approved plan to consolidate operations and reduce costs and expenses. The restructuring charge consisted of \$1,259,769 in net cash expenditures (primarily employee termination costs), all of which had been paid as of September 30, 1997, and \$9,211,713 resulting from the write-down of asset carrying values. (See Note 4 to the Company's consolidated financial statements).

OTHER DEVELOPMENTS

On December 16, 1999, the Company announced that it expects revenue for the fiscal 2000 first quarter ending December 31, 1999 to be in a range of \$39 million to \$41 million and earnings per diluted share to be in a range of \$0.03 to \$0.07. The Company attributes the lower than expected revenues and earnings for the first quarter primarily to two factors associated with Year 2000 concerns. Sales to the Company's OEM customers have been affected by a temporary change in the purchasing patterns of end users until after January 2000. Sales into the Company's distribution channel have been impacted similarly by end-user purchasing behavior and also more significantly by inventory reductions as channel participants reduce levels due to Year 2000 concerns.

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ITEM 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS (CONTINUED)

ACQUIRED IN-PROCESS RESEARCH AND DEVELOPMENT

ACQUISITION OF ITK INTERNATIONAL, INC.:

In July 1998, the Company acquired all of the outstanding common stock of ITK. The transaction was accounted for using the purchase method of accounting. Accordingly, the purchase price was allocated to the estimated fair value of assets acquired and liabilities assumed, including estimated restructuring and integration costs of \$3,484,000. (See Note 4 to the Company's consolidated financial statements).

At the time of the Company's acquisition, ITK described itself as a Remote

Access Server (RAS) product company. Although ITK did offer its own line of ISDN cards and networking boards, the Company's acquisition was made principally to acquire the voice over Internet Protocol (VoIP) technology under development by ITK. This VoIP technology, if successfully developed, would allow users to send packetized voice signals through the Internet. The Company believes that the VoIP technology under development at the time of the acquisition could provide for the development of products which would be a natural extension of the Company's current product offerings and could position the Company to address substantially larger markets than the markets served by the Company's current products.

At the time of the acquisition, ITK had developed a proof of concept prototype product ("NetBlazer 8500") which demonstrated that the method of voice and data compression under development by ITK and the method of combining VoIP and remote access functionality under development by ITK had the potential to be further developed into a product marketable to "Carrier Class" telephone companies. However, the NetBlazer 8500 required further development before it could meet the technical and functional requirements of such customers. Accordingly, the Company is uncertain whether the VoIP technology being developed will ultimately meet the technical requirements of Carrier Class telephony customers or whether it will be commercially viable.

As of the date of the acquisition, the nature of the development efforts related to the purchased, in-process research and development projects, as well as the efforts required to complete development of those projects into commercially viable products, included development projects to address the following: (a) development of enhanced technical attributes, including enhanced port density, redundancy, network management capabilities, a higher fault tolerance, compliance with telephone industry standards such as "SS7" and "NEBS" compliance; (b) development of significant hardware and software functions considered integral to a product with broad appeal to end users and the telephone companies, including computer-to-phone capabilities, interoperability with other vendor's gateways, one-stage dialing, local tone simulation and announcements, end-to-end transparent disconnect cause delivery and real-time FAX-over capabilities, among others; and (c) re-engineering of the prototype design to permit cost effective manufacture and commercial use, including migration from a UNIX operating system to a Windows NT operating system.

It is not certain that development efforts on these projects will allow for Carrier Class telephone company and end-user specifications to be met. Failure to achieve these specifications or to achieve market viability will cause the VoIP projects to fail. If these products are not successfully developed, the sales and profitability of the Company may be adversely affected in future periods. Additionally, the value of other identifiable intangible assets and goodwill acquired may become impaired.

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ITEM 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS (CONTINUED)

ACQUIRED IN-PROCESS RESEARCH AND DEVELOPMENT (CONTINUED)

ACQUISITION OF ITK INTERNATIONAL, INC.: (CONTINUED)

Management estimates that \$11.3 million of the purchase price represents the fair value of purchased in-process research and development related to the VoIP projects referred to above, that had not yet reached technological feasibility and had no alternative future uses. These amounts were expensed as a non-recurring, non-tax-deductible charge upon consummation of the acquisition.

The Company utilized the alternative income valuation approach to determine the estimated fair value of the purchased in-process research and development. This estimate is based on the following assumptions:

- o The estimated revenues are based upon projected average annual revenue growth rates from future products expected to be derived once technological feasibility is achieved of between 18% and 65% during the period from 2000 through 2005, starting with an estimated growth rate of 65% from 2000 to 2001 with steadily declining rates of estimated revenue growth through 2005. Estimated total revenues expected from products to be developed using purchased in-process research and development peak in the year 2005 and

decline rapidly in 2006 and 2007 as other new products are expected to enter the market. These projections are based on estimates made by the Company's management of market size and growth (which are supported by independent market data), expected trends in technology and the nature and expected timing of new product introductions by ITK and its competitors.

- o The estimated costs of sales are based upon the historical, stand-alone costs of ITK without considering any synergies due to the acquisition by the Company.
- o The estimated selling, general and administrative expenses of between 37% and 32% of revenues from 2000 through 2003 and between 29% and 27% of revenues between 2004 and 2007, are based upon the estimated expense levels of ITK as derived from the historical, stand-alone costs of ITK without considering any synergies due to the acquisition by the Company.
- o The discount rate utilized in the alternative income valuation approach is based on the weighted average cost of capital (WACC). The WACC calculation produces the average required rate of return of an investment in an operating enterprise, based on various required rates of return from investments in various areas of that enterprise. The WACC estimated by an independent third-party appraiser for the Company, as a corporate business enterprise is 14%. The discount rate used in the alternative valuation approach was 30%. This discount rate is higher than the WACC due to the inherent uncertainties in the estimates described above including uncertainty surrounding the successful development of purchased research and development, the estimated useful life of such completed research and development, the profitability levels of such completed research and development and the uncertainty of technological advances that are unknown at this time.

The Company estimated that the purchased in-process research and development related to VoIP was 83% complete as of the acquisition date. This estimate was based upon research and development costs

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ITEM 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS (CONTINUED)

ACQUIRED IN-PROCESS RESEARCH AND DEVELOPMENT (CONTINUED)

ACQUISITION OF ITK INTERNATIONAL, INC.: (CONTINUED)

incurred to date compared to total estimated development costs. As of the date of acquisition, the estimated cost to complete the VoIP to a point of technological feasibility was approximately \$2.3 million, expected to be incurred over a period of approximately 20 months following the acquisition. This estimate is subject to change, given the uncertainties of the development process, and no assurance can be given that deviations from these estimates will not occur.

The identifiable intangible assets of \$21,100,000 included in the purchase price allocation set forth above are comprised of proven technology with an estimated fair value of \$19,700,000 and an assembled workforce with an estimated fair value of \$1,400,000, which have estimated useful lives of five years and six years, respectively. The remaining unallocated purchase price represents goodwill of \$17,727,086, which is being amortized over seven years. With regard to the proven technology, the Company intends to further enhance the strengths of this product range and implement a plan to gain leadership in the ISDN market. The Company's core asset is the comprehensive set of common application programming interface (CAPI) and CAPI-enhancing features combined with highly intelligent ISDN protocol implementation which provide for integration into server-based communication solutions for the media communication market.

The Company is continuing development of the acquired in-process VoIP technology and, as of September 30, 1999, believes that its development efforts are on schedule to meet the product release schedule referred to above with potential increases in its research and development costs. However, these expectations are subject to change, given the uncertainties of the development process and changes in market expectations. Development costs incurred were \$1.9 million during the year ended September 30, 1999. The current version of the NetBlazer 8500, which includes a sub-set of the ultimate feature set, provided revenues of

\$3.0 million during fiscal 1999.

ACQUISITION OF CENTRAL DATA CORPORATION:

In July 1998, the Company acquired all of the outstanding common stock of CDC. The transaction was accounted for using the purchase method of accounting. Accordingly, the purchase price was allocated to the estimated fair value of assets acquired and liabilities assumed, including estimated restructuring and integration costs of \$750,000. (See Note 4 to the Company's consolidated financial statements).

Although CDC did offer its own line of traditional serial port connectivity products, the Company's acquisition was made principally to acquire the Universal Serial Bus (USB) technology under development by CDC. This USB technology, if successfully developed, would broaden the Company's product offerings to include this new, emerging industry-standard port technology. Management considers such a product offering integral to its future market share because the marketplace is migrating from the traditional serial I/O (input/output) technology (in which the Company has significant market share) to USB technology. The Company also believes that it can reduce its time to market by 12 to 18

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ITEM 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS (CONTINUED)

ACQUIRED IN-PROCESS RESEARCH AND DEVELOPMENT (CONTINUED)

ACQUISITION OF CENTRAL DATA CORPORATION: (CONTINUED)

months by acquiring CDC's in-process research and development rather than initiating development of its own USB technology.

At the time of acquisition, CDC had developed a prototype of both the 2-port and 4-port USB connectivity technologies that demonstrated the validity of CDC's product development plan. However, the USB technology development was still in process, and required significant development work and field testing before it could meet the technical and functional requirements of customers and achieve commercial viability. Accordingly, the Company was uncertain whether the technology being developed could ultimately meet the technical and economic requirements of the marketplace and become commercially viable.

As of the date of the acquisition, the nature of the development efforts related to the purchased, in-process research and development projects, as well as the efforts required to complete development of these projects into commercially viable products included: (a) development of new hardware designs and software engineering relating to a complete reengineering of the in-process USB technology; (b) development of new hardware designs for 8-port USB products; and (c) development of a new "hub" architecture to support the CDC USB technology.

It is not certain that development efforts on these projects will allow for user specifications to be met or commercial viability to be achieved. Failure to achieve these specifications or to achieve market viability will cause the USB projects to fail. If these products are not successfully developed, the sales and profitability of the Company may be adversely affected in future periods. Additionally, the value of other identifiable intangible assets and goodwill acquired may become impaired.

Management estimates that \$4.7 million of the purchase price represents the fair value of purchased in-process research and development related to the USB projects referred to above, that had not yet reached technological feasibility and had no alternative future uses. These amounts were expensed as a non-recurring, non-tax-deductible charge upon consummation of the acquisition.

The Company utilized the alternative income valuation approach to determine the estimated fair value of the purchased in-process research and development. These estimates are based on the following assumptions:

- o The estimated revenues are based upon projected average annual revenue growth rates from future products expected to be derived once technological feasibility is achieved of between 9% and 52% during the period from 1999 through 2002, starting with an estimated growth rate of 52% from 1999 to

2000 with a declining rate of estimated revenue growth through 2002. Estimated total revenues expected from products to be developed using purchased in-process research and development peak in the year 2002 and decline rapidly in 2003 and 2004 as other new products are expected to enter the market. These projections are based on estimates made by the Company's management of market size and growth (which are supported by independent market data), expected trends in technology and the nature and expected timing of new product introductions by CDC and its competitors.

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ITEM 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS (CONTINUED)

ACQUIRED IN-PROCESS RESEARCH AND DEVELOPMENT (CONTINUED)

ACQUISITION OF CENTRAL DATA CORPORATION: (CONTINUED)

- o The estimated costs of sales are based upon the historical, stand-alone costs of CDC without considering any synergies due to the acquisition by the Company.
- o The estimated selling, general and administrative expenses of between 35% and 30% of revenues from 1999 to 2003 and 27% of revenues in 2004, are based upon the estimated expense levels of CDC as derived from the historical, stand-alone costs of CDC without considering any synergies due to the acquisition by the Company.
- o The discount rate utilized in the alternative income valuation approach is based on the weighted average cost of capital (WACC). The WACC calculation produces the average required rate of return of an investment in an operating enterprise, based on various required rates of return from investments in various areas of that enterprise. The WACC estimated by an independent third-party appraiser for the Company, as a corporate business enterprise, is 14%. The discount rate used in the alternative valuation approach was 30%. This discount rate is higher than the WACC due to the inherent uncertainties in the estimates described above including uncertainty surrounding the successful development of purchased research and development, the estimated useful life of such completed research and development, the profitability levels of such completed research and development and the uncertainty of technological advances that are unknown at this time.

The Company estimated that the purchased in-process research and development related to USB was 87% complete as of the acquisition date. This estimate was based upon research and development costs incurred to date compared to total estimated development costs. As of the date of acquisition, the estimated cost to complete the USB technology to a point of technological feasibility was approximately \$600,000, expected to be incurred over a period of approximately nine months following the acquisition. This estimate is subject to change, given the uncertainties of the development process, and no assurance can be given that deviations from these estimates will not occur.

The identifiable intangible assets of \$9,800,000 included in the purchase price allocation set forth above are comprised of proven technology with an estimated fair value of \$9,400,000, and an assembled workforce with an estimated fair value of \$400,000, which have estimated useful lives of five years and six years, respectively. The remaining unallocated purchase price represents goodwill in the amount of \$9,711,298, which is being amortized over seven years.

The Company has developed the acquired in-process USB research and development and released USB products, with initial product revenues generated during November 1998. Included in revenues for fiscal 1999 is approximately \$266,000 of revenues from the first release of certain USB products. Actual revenues are below original projections due to delays in the release and marketing of certain USB products. Research and development expenditures incurred to advance the acquired in-process USB technology were \$500,000 for fiscal 1999.

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ITEM 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND

RESULTS OF OPERATIONS (CONTINUED)

OTHER (EXPENSE) INCOME

Other expense of \$256,000 in 1999 consisted of \$1,015,000 of interest expense on lines of credit and long term debt, \$856,000 of interest income on short term investments, and \$97,000 of miscellaneous other expense. Other income for 1998 included primarily interest income on cash equivalents and a fiscal 1998 third-quarter reversal of a \$1.4 million previously accrued obligation related to lease guarantees for AetherWorks Corporation. As discussed in the next item below, the obligation is no longer required because the Company is no longer the primary guarantor for these leases.

AETHERWORKS CORPORATION
NET LOSS AND WRITE-OFF

In connection with the Company's previously purchased \$13.8 million of convertible notes from AetherWorks Corporation, in May 1998 the Company exchanged such notes for a non-interest bearing \$8.0 million non-convertible note and was released from all of its guarantees of certain lease obligations of AetherWorks. Due to significant uncertainty as to its collectibility, the \$8.0 million note, which matures in 2001, has been recorded by the Company as having no carrying value. In fiscal 1997 the Company used the equity method to account for its investment in AetherWorks and record a net loss of \$5.8 million, which represented 100% of AetherWorks' loss for the year. The percentage of AetherWorks' net losses included in the Company's financial statements was based upon the percentage of financial support provided by the Company (versus other investors) during 1997. The Company wrote off its investment in AetherWorks as of September 30, 1997, and recorded a \$5.8 million charge, composed of its \$2.4 million remaining investment, its \$2.0 million remaining obligation to purchase additional notes and \$1.4 million for the obligation to guarantee certain AetherWorks leases. The Company no longer has any funding obligations or any potential equity interest in or management control over AetherWorks. Consequently, the Company has not included any of AetherWorks' net losses in its results of operations during fiscal 1999 and fiscal 1998.

INCOME TAXES

The Company recorded a \$4.8 million tax provision for 1999 and \$9.3 million tax provision for 1998. These tax provision amounts were required primarily because of the write-off of acquired in-process research and development and because the amortization of certain identifiable intangible assets and goodwill acquired in the purchase of ITK and CDC is not deductible for income tax reporting purposes. In 1997, the Company recorded a \$0.1 million tax provision, while reporting a pre-tax loss for that year. That provision was necessary due to the non-deductibility of certain intangible assets written off as part of the restructuring charge, the AetherWorks net losses and the related investment write-off.

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ITEM 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND
RESULTS OF OPERATIONS (CONTINUED)

INFLATION

The Company believes inflation has not had a material effect on its operations or its financial condition.

LIQUIDITY AND CAPITAL RESOURCES

The Company has financed its operations principally with funds generated from operations, and, in prior years, with proceeds from earlier public offerings.

The Company's working capital increased from \$37.9 million at September 30, 1998, to \$59.9 million at September 30, 1999. The Company maintains lines of credit with various financial institutions providing for borrowings of up to \$15.9 million, depending upon levels of eligible accounts receivable and inventories. As of September 30, 1999, \$4.8 million had been borrowed under these line of credit agreements.

During 1999, the Company increased cash balances by approximately \$10.6 million, through cash flow from operations, principally due to an increase in cash

generated from operations.

Investing activities consisted of net investments of \$13.7 in marketable securities and purchases of \$4.8 million of equipment, capital improvements, and expansion of the Company's enterprise-wide Enterprise Resource Planning (ERP) software system into locations outside of the Minnetonka headquarters.

Financing activities consisted of payments on line of credit and debt obligations totaling \$5.9 million and \$815,000 for repurchase of shares of the Company's common stock, which was offset by \$3.0 million received from the exercise of employee stock options and employee stock purchase plan transactions.

In September 1998, the Board of Directors authorized a program to repurchase up to one million shares of the Company's common stock for use in the Company's benefit plans. As of September 30, 1999, 120,000 shares had been repurchased under this program at a weighted average price of \$8.03.

The Company's management believes that current financial resources, cash generated from operations and the Company's potential capacity for debt and/or equity financing will be sufficient to fund current and future business operations.

FOREIGN CURRENCY TRANSLATION

Effective January 1, 1999, eleven countries of the European Union converted to a common currency called the "Euro." This action will cause some of the Company's European transactions to be negotiated, invoiced, and paid in "Euros." The conversion will most likely add currency exchange costs and risks, although such costs and risks are not quantifiable at this time.

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ITEM 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS (CONTINUED)

FOREIGN CURRENCY TRANSLATION (CONTINUED)

During 1999, the Company had approximately \$67.4 million of net sales related to foreign customers, of which \$44.8 million was in U.S. dollars and \$22.6 was in Deutschemark-denominated sales. During fiscal 1999 the average monthly exchange rate for the Deutschemark to the U.S. dollar dropped by approximately 12% from .6103 to .5370 U.S. dollars to the Deutschemark, respectively.

In future periods, a significant portion of sales will be made in Deutschemarks until full integration of the "Euro" is achieved. The Company has not implemented a hedging strategy to reduce the risk of foreign currency translation exposures.

YEAR 2000 READINESS DISCLOSURE

This section contains certain statements that are forward-looking statements within the meaning of Section 27A of the Securities Act of 1933, as amended, and Section 21E of the Securities Exchange Act of 1934, as amended. The Company's Year 2000 readiness, and the effects of the Year 2000 on the Company may be differ materially from currently projected. This may be due to, among other things, delays in the implementation of the Company's Year 2000 Plan, which includes contingency plans, and the failure of key third parties with whom the Company transacts business to achieve Year 2000 compliance. The Company faces risk to the extent that suppliers of products and services purchased by the Company and others with whom the Company transacts business on a world-wide basis do not have business products and services that comply with year 2000 requirements. The Company has obtained assurances from most of its key suppliers that their products and services are year 2000 compliant. In the event any such third parties cannot, in a timely manner, provide the Company with products and services that meet the year 2000 requirements, the Company's operating results could be materially adversely affected.

The Company began a comprehensive project in 1996 to prepare its products and its enterprise-wide information management system and other internal computer systems for the year 2000. The Company believes its implementation of a new enterprise-wide information management system, principally installed to improve operating efficiency, will address the Company's internal year 2000 compliance

issues. The worldwide rollout of this system was completed on September 30, 1999.

Most of the Company's products are year 2000 compliant because there is very little or no date processing involved. Certain products, including end-of-life versions, do require customer action such as a patch or version upgrade to be compliant. These products have been identified, and the Company has notified impacted customers. Overall, management believes the year 2000 will not have a significant impact on operations.

The Company plans to continue with remediation and testing efforts with both its products and internal systems to further mitigate any risks associated with the year 2000. Contingency plans have been established in order to transact business at sufficient levels in the case of adverse events related to the Year 2000 date change. In addition, the Company will monitor the enterprise computer systems, LAN/WAN, and the computer room environments for temperature, continuous power supply, and transaction integrity. Facility personnel will be monitoring owned and leased buildings for heating and security.

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ITEM 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS (CONTINUED)

YEAR 2000 READINESS DISCLOSURE (CONTINUED)

The costs associated with the year 2000 project have been minimal and are not incremental to the Company, but include temporary reallocation of existing resources. However, there can be no assurances that various factors relating to the Year 2000 compliance issues, including litigation, will not have a material adverse effect on the Company's business, operating results, or financial position.

While the Company believes it is prepared for Year 2000 issues and has an effective program in place to resolve the impact of a Year 2000 issue in a timely manner, there can be no assurance that the failure of the Company or of the third parties with whom the Company transacts business to adequately address their respective Year 2000 issues, will not have a material adverse effect on the Company's business, financial condition, cash flows and results of operations.

NEW ACCOUNTING STANDARDS

See Note 1 to the Company's consolidated financial statements.

ITEM 7A. QUANTITATIVE AND QUALITATIVE DISCLOSURES ABOUT MARKET RISK

Not applicable.

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ITEM 8. FINANCIAL STATEMENTS AND SUPPLEMENTARY DATA

CONSOLIDATED STATEMENTS OF OPERATIONS

For the fiscal years ended September 30	1999	1998	1997
	As Restated-See Note 2		
Net sales	\$ 193,506,059	\$ 182,931,670	\$ 165,597,937
Cost of sales	95,313,636	88,539,156	85,482,536
Gross Margin	98,192,423	94,392,514	80,115,401
Operating expenses:			
Sales and marketing	41,002,559	37,288,027	36,671,271
Research and development	24,689,228	16,963,410	17,978,135
General and administrative	23,657,586	17,011,504	19,324,777
Acquired in-process research and development	-	16,064,933	-
Restructuring	607,398	1,020,000	10,471,482

Total operating expenses	89,956,771	88,347,874	84,445,665
Operating income (loss)	8,235,652	6,044,640	(4,330,264)
Other (expense) income, net	(256,320)	1,818,286	153,809
AetherWorks Corporation net operating loss	-	-	(5,761,201)
AetherWorks Corporation gain (write-off)	-	1,350,000	(5,758,548)
Income (loss) before income taxes	7,979,332	9,212,926	(15,699,204)
Provision for income taxes	4,787,599	9,284,020	91,640
Net income (loss)	\$ 3,191,733	\$ (71,094)	\$ (15,790,844)
Net income (loss) per common share, basic	\$ 0.22	\$ (0.01)	\$ (1.18)
Net income (loss) per common share, assuming dilution	\$ 0.22	\$ (0.01)	\$ (1.18)
Weighted average common shares, basic	14,696,057	13,729,765	13,393,408
Weighted average common shares, assuming dilution	14,831,242	13,729,765	13,393,408

The accompanying notes are an integral part of the consolidated financial statements

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ITEM 8. FINANCIAL STATEMENTS AND SUPPLEMENTARY DATA (CONTINUED)

CONSOLIDATED BALANCE SHEETS

At September 30,	1999	1998
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		As Restated-See Note 2
ASSETS		
Current assets:		
Cash and cash equivalents	\$ 20,963,607	\$ 10,350,368
Marketable securities	13,714,422	-
Accounts receivable, net	33,955,669	47,787,978
Inventories, net	22,446,667	27,362,924
Other	5,394,366	6,146,941
Total current assets	96,474,711	90,949,211
Property, equipment and improvements, net	30,747,877	33,990,973
Intangible assets, net	47,804,611	63,602,435
Other	7,807,829	2,978,883
Total assets	\$176,336,026	\$191,521,452
LIABILITIES AND STOCKHOLDERS' EQUITY		
Current liabilities:		
Borrowings under line of credit agreements	\$ 4,759,095	\$ 10,707,000
Current portion of long-term debt	330,028	284,075
Accounts payable	10,779,998	15,255,173
Income taxes payable	5,264,181	3,597,588
Accrued expenses:		
Advertising	2,461,487	2,651,742
Compensation	6,938,230	6,778,293
Other	6,357,348	8,347,668
Restructuring reserves	788,298	5,254,000
Total current liabilities	40,528,615	53,659,486
Long-term debt	9,205,318	11,124,446
Net deferred income taxes	3,437,133	5,817,933
Other	-	275,000
Total liabilities	49,165,666	70,770,865
Commitments and contingencies		
Stockholders' equity:		
Preferred stock, \$0.01 par value; 2,000,000 shares authorized; none outstanding		
Common stock, \$0.01 par value; 60,000,000 shares		

authorized; 15,192,697 and 15,790,975 shares issued	161,930	157,910
Additional paid-in capital	77,460,610	70,461,123
Retained earnings	78,234,541	75,042,938
Cumulative foreign currency translation adjustment	(1,027,533)	(617,859)
	<u>148,829,550</u>	<u>144,846,332</u>
Unearned stock compensation	(339,666)	(7,700,635)
Treasury stock, at cost, 1,271,612 and 1,247,094 shares	<u>(21,325,502)</u>	<u>(21,894,812)</u>
Total stockholders' equity	<u>127,164,362</u>	<u>121,750,885</u>
Total liabilities and stockholders' equity	<u>\$176,330,028</u>	<u>\$ 167,537,450</u>

The accompanying notes are an integral part of the consolidated financial statements

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ITEM 8. FINANCIAL STATEMENTS AND SUPPLEMENTARY DATA (CONTINUED)

CONSOLIDATED STATEMENTS OF CASH FLOWS

For the fiscal years ended September 30,

	1999	1998	1997
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		As Restated See Note 2	
Operating activities:			
Net income (loss)	\$ 3,191,733	\$ (7,090)	\$ (5,730,844)
Adjustments to reconcile net income (loss) to cash provided by operating activities:			
Acquired in-process research and development		6,064,933	
Restructuring	(670,167)	7,020,000	4,277,713
Depreciation of property and equipment	5,999,640	5,174,725	5,587,132
Amortization of intangibles	12,807,568	3,665,819	1,174,093
AuthorWorks Corporation net loss			3,764,201
AuthorWorks Corporation (gain) write-off		(1,259,000)	3,758,510
Gain on sale of fixed assets	94,824	159,498	70,885
Provision for losses on accounts receivable	179,356	739,992	1,533,251
Provision for inventory obsolescence	6,219,261	3,614,240	2,940,998
Deferred income taxes	(2,716,066)	(7,287,611)	(1,187,933)
Stock compensation	362,081	825,001	244,560
Changes in operating assets and liabilities:			
Accounts receivable	10,554,264	(17,687,833)	13,283,125
Inventories	(1,619,415)	(562,829)	3,780,211
Treasury stock payable	7,761,296	833,900	3,447,612
Other assets	2,238,847	(3,227,695)	723,772
Accounts payable	(3,822,046)	273,238	(2,430,817)
Accrued expenses and other liabilities	(4,029,820)	2,289,156	153,148
Total adjustments	<u>39,112,286</u>	<u>67,609,012</u>	<u>57,444,128</u>
Net cash provided by operating activities	<u>42,304,019</u>	<u>60,519,912</u>	<u>51,713,284</u>
Investing activities:			
Purchase of property and equipment and certain other intangible assets	(4,756,893)	(9,816,163)	(8,847,173)
Proceeds from sale of fixed assets	819,993		
Purchase of held-for-sale marketable securities	(29,632,113)		
Proceeds from sale of held-for-sale marketable securities	7,000,000		
Business acquisitions, net of cash acquired		(27,456,560)	
Investment in AuthorWorks Corporation	-	(7,000,000)	(6,500,000)
Net cash used in investing activities	<u>(17,579,013)</u>	<u>(35,172,723)</u>	<u>(15,347,173)</u>
Financing activities:			
Payments on long-term debt	(5,415,843)	(18,000)	
Proceeds from the issuance of long-term debt		2,064,865	
Purchase of treasury stock	(815,000)	(153,750)	
Stock option transactions, net	2,561,427	7,419,570	539,838
Employee stock purchase plan transactions, net	386,324	17,629	194,327
Net cash (used in) provided by financing activities	<u>(3,703,092)</u>	<u>4,629,314</u>	<u>1,974,165</u>
Effect of exchange rates changes on cash and cash equivalents	(1,363,672)	(419,805)	
Net increase (decrease) in cash and cash equivalents	<u>19,608,239</u>	<u>(20,974,298)</u>	<u>22,380,276</u>
Cash and cash equivalents, beginning of period	<u>\$ 10,554,866</u>	<u>\$ 31,429,666</u>	<u>\$ 8,543,650</u>
Cash and cash equivalents, end of period	<u>\$ 20,963,105</u>	<u>\$ 10,455,368</u>	<u>\$ 31,329,666</u>
Supplemental cash flows information:			
Treasury stock	\$ 937,306	\$ 224,730	\$ 205,000
Income taxes paid	\$ 3,742,896	\$ 7,463,578	\$ 235,439

The accompanying notes are an integral part of the consolidated financial statements

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ITEM 8. FINANCIAL STATEMENTS AND SUPPLEMENTARY DATA (CONTINUED)

CONSOLIDATED STATEMENTS OF STOCKHOLDERS' EQUITY AND COMPREHENSIVE INCOME

Consolidated Statements of Stockholders' Equity

For the years ended September 30, 1999, 1998 and 1997

	Common Stock Shares	Par Value	Treasury Stock Shares	Value	Additional Paid-in-Capital
Balance, September 30, 1996	11,602,150	\$146,722	1,336,864	\$ (23,616,979)	\$42,866,708
Employee Stock Purchase Issuances			(69,402)	1,274,391	(740,060)
Assuance of stock options at below market prices					1,390,015
Stock compensation					
Assuance of stock upon exercise of stock options, net of withholding	50,196	501			379,720
Tax benefit realized upon exercise of stock options					158,617
Forfeiture of stock options					(151,940)
Net loss					
Balance, September 30, 1997	11,712,256	147,223	1,269,162	(22,405,588)	44,409,102
Assuance of stock for acquisitions	775,437	7,754			21,404,797
Purchase of treasury stock, at cost			15,000	(153,750)	
Employee Stock Purchase Issuances			(85,588)	664,626	(192,890)
Assuance of stock options at below market prices					977,697
Stock compensation					
Assuance of stock upon exercise of stock options, net of withholding	289,882	2,899			2,307,742
Tax benefit realized upon exercise of stock options					1,305,001
Forfeiture of stock options					(168,319)
Foreign currency translation adjustment					
Net loss					
Balance, September 30, 1998 (As Restated-See Note 2)	12,756,575	\$17,900	1,241,094	(21,894,812)	49,461,723
Purchase of treasury stock, at cost			105,000	(815,000)	
Employee Stock Purchase Issuances			(80,421)	1,384,310	(197,956)
Stock compensation					
Assuance of stock upon exercise of stock options, net of withholding	402,022	4,020			2,577,402
Tax benefit realized upon exercise of stock options					199,041
Forfeiture of stock options					(177,958)
Foreign currency translation adjustment					
Net income					
Balance, September 30, 1999	13,558,597	\$19,920	1,271,612	(21,325,502)	\$51,460,612

The accompanying notes are an integral part of the consolidated financial statements

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ITEM 8. FINANCIAL STATEMENTS AND SUPPLEMENTARY DATA (CONTINUED)

CONSOLIDATED STATEMENTS OF STOCKHOLDERS' EQUITY AND COMPREHENSIVE INCOME
(CONTINUED)

Consolidated Statements of Stockholders' Equity

For the years ended September 30, 1999, 1998 and 1997

	Retained Earnings	Unearned Stock Compensation	Cumulative Translation	Total Stockholders' Equity	Comprehensive (Loss) Income
Balance, September 30, 1996	\$ 90,934,446	\$ (295,150)		\$ 90,639,296	
Employee Stock Purchase Issuances				531,327	
Assuance of stock options at below market prices		(1,892,515)			
Stock compensation		244,569		244,569	

Issuance of stock upon exercise of stock options, net of withholding				380,221	
Tax benefit realized upon exercise of stock options				159,617	
Forfeiture of stock options		154,314			
Net loss	(15,790,844)			(15,790,844)	\$ (15,790,844)
<hr/>					
Balance, September 30, 1997	15,113,902	(1,787,658)		95,401,037	\$ (15,790,844)
<hr/>					
Issuance of stock for acquisitions				21,837,555	
Purchase of treasury stock, at cost				(155,750)	
Employee Stock Purchase Issuances				471,629	
Issuance of stock options at below market prices		(477,687)			
Stock compensation		895,401		895,401	
Issuance of stock upon exercise of stock options, net of withholding				2,300,621	
Tax benefit realized upon exercise of stock options				1,305,007	
Forfeiture of stock options		169,319			
Foreign currency translation adjustment			\$ (875,809)	(875,809)	(815,809)
Net loss	(71,684)			(71,684)	(71,684)
<hr/>					
Balance, September 30, 1998	15,042,218	(1,700,635)	(875,809)	121,250,585	\$ (886,903)
<hr/>					
Purchase of treasury stock, at cost				(815,000)	
Employee Stock Purchase Issuances				580,324	
Stock compensation		582,481		582,481	
Issuance of stock upon exercise of stock options, net of withholding				2,381,422	
Tax benefit realized upon exercise of stock options				198,041	
Forfeiture of stock options		777,968			
Foreign currency translation adjustment			(211,724)	(211,724)	(211,724)
Net income	3,197,433			3,197,433	3,197,433
<hr/>					
Balance, September 30, 1999	\$ 18,239,651	\$ (339,684)	\$ (1,027,533)	\$ 127,760,302	\$ 2,989,069

The accompanying notes are an integral part of the consolidated financial statements

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS

1. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

BUSINESS DESCRIPTION

Digi International is a leading worldwide provider of data communications products for open systems, server-based communications, Internet telephony, and local area network (LAN) applications. Digi's communications products support a broad range of server platforms and network operating systems that enable people to access information.

Digi's products are marketed through a global network of distributors, system integrators, original equipment manufacturers (OEMs), as well as thousands of value-added resellers (VARs).

PRINCIPLES OF CONSOLIDATION

The consolidated financial statements include the accounts of the Company and its wholly-owned subsidiaries. All significant intercompany accounts and transactions have been eliminated in consolidation.

CASH EQUIVALENTS AND MARKETABLE SECURITIES

The Company considers all highly liquid investments purchased with an original maturity of three months or less to be cash equivalents. Those having original maturities in excess of three months are classified as marketable securities. Marketable Securities consist of high-grade commercial paper and have maturities of less than one year. Marketable securities classified as held to maturity are carried at amortized cost. Gross unrealized holding gains and losses were \$10,361 and \$5,383 as of September 30, 1999. The Company had no marketable securities as of September 30, 1998.

REVENUE RECOGNITION

Revenue is recognized at the date of shipment. Estimated warranty costs and customer returns are recorded at the time of sale.

The Company offers rebates to authorized domestic and international distributors and authorized resellers. The rebates are incurred based on the level of sales to the respective distributors and resellers, and are charged to operations in the same period as the corresponding sales.

INVENTORIES

Inventories are stated at the lower of cost or fair market value, with cost determined on the first-in, first-out method. Fair market value for raw materials is based on replacement cost and for other inventory classifications based on net realizable value. Appropriate consideration is given to deterioration, obsolescence and other factors in evaluating net realizable value.

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

1. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (CONTINUED)

PROPERTY, EQUIPMENT AND IMPROVEMENTS

Property, equipment and improvements are carried at cost. Depreciation is provided by charges to operations using the straight-line method based on estimated useful lives, ranging from three to 39 years.

Expenditures for maintenance and repairs are charged to operations as incurred, while major renewals and betterments are capitalized. The assets and related accumulated depreciation accounts are adjusted for asset retirements and disposals with the resulting gain or loss included in operations.

The Company's cost of business process reengineering activities, whether done internally or by third parties, is expensed as incurred.

INTANGIBLE ASSETS

Purchased proven technology, license agreements, covenants not to compete and other intangible assets are recorded at cost. Goodwill represents the excess of cost over the fair value of identifiable assets acquired and is being amortized on a straight-line basis over estimated useful life periods ranging from five to 15 years. Purchased in process research and development costs (IPR&D) are expensed upon consummation of the purchase. All other intangible assets are amortized on a straight-line basis over their estimated useful lives of one to seven years.

The Company periodically, at least quarterly, analyzes intangible assets for potential impairment, assessing the appropriateness of lives and recoverability of unamortized balances through measurement of undiscounted operating cash flows on a basis consistent with generally accepted accounting principles.

RESEARCH AND DEVELOPMENT

Research and development costs are expensed when incurred. Software development costs are expensed as incurred. Such costs are required to be expensed until the point that technological feasibility and proven marketability of the product are established. Costs otherwise capitalized after such point also are expensed because they are insignificant.

INCOME TAXES

Deferred income taxes are recognized for the tax consequences in future years of differences between the tax bases of assets and liabilities and their financial reporting amounts at each year end based on enacted tax laws and statutory tax rates applicable to the periods in which the differences are expected to affect taxable income. Income tax expense is the tax payable for the period and the change during the period in deferred tax assets and liabilities.

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

1. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (CONTINUED)

INCOME TAXES (CONTINUED)

Tax credits are accounted for under the flow-through method, which recognizes the benefit in the year in which the credit is utilized.

INCOME (LOSS) PER COMMON SHARE

Basic net income (loss) per share is calculated based on only the weighted average of common shares outstanding during the period. Net income (loss) per share, assuming dilution, is computed by dividing net income (loss) by the weighted average number of common and common equivalent shares outstanding. The Company's only common stock equivalents are those that result from dilutive common stock options. The calculation of diluted earnings per common share for 1999 includes 135,185 of such common stock equivalents. The calculation of diluted loss per common share for 1998 and 1997 excludes 835,670 and 236,165 equivalent shares, respectively, of the Company's common stock attributable to common stock options because their effect would be antidilutive.

FOREIGN CURRENCY TRANSLATION

Financial position and results of operations of the Company's international subsidiaries are measured using local currencies as the functional currency. Assets and liabilities of these operations are translated at the exchange rates in effect at each fiscal year-end. Statements of operations accounts are translated at the average rates of exchange prevailing during the year. Translation adjustments arising from the use of differing exchange rates from period to period are included in the cumulative translation account in stockholders' equity.

USE OF ESTIMATES

The preparation of consolidated financial statements in conformity with generally accepted accounting principles requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities at the date of the financial statements and the reported amounts of revenues and expenses during the reporting period. Actual results could differ from those estimates.

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

1. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (CONTINUED)

COMPREHENSIVE INCOME

During the first quarter of fiscal 1999, the Company adopted Statement of Financial Accounting Standards No. 130 (FAS 130), "Reporting Comprehensive Income". FAS 130 requires the Company to report in the consolidated financial statements, in addition to net income, comprehensive income and its components including foreign currency items and unrealized gains and losses of certain investments in debt and equity securities. Comprehensive income is defined as "the change in equity (net assets) of a business enterprise during a period from transactions and other events and circumstances from non-owner sources." It includes all changes in equity during a period except those resulting from investment by owners and distributions to owners.

SEGMENT REPORTING

For the year ended September 30, 1999, the Company adopted Statement of Financial Accounting Standards No. 131 (FAS 131), "Disclosures about Segments of an Enterprise and Related Information". This statement establishes standards for reporting information about operating segments in annual financial statements and requires selected information about operating segments in interim financial reports issued to stockholders. It also establishes standards for related disclosures about products and services, geographic areas and major customers. Under FAS 131, operating segments are to be determined consistent with the way that management organizes and evaluates financial information internally, makes operating decisions, and assesses performance.

RECLASSIFICATION OF CERTAIN ITEMS

Accrued sales discounts and allowances of \$1,461,167, which previously were included in accrued expenses, have been reclassified into net accounts receivable for the year ended September 30, 1998. This reclassification had no impact on previously reported operating income, or net income.

Costs of \$2,647,207 relating to systems support and communications costs, which previously were included in general and administrative expenses, have been reclassified into sales and marketing and research and development expenses for the year ended September 30, 1997. This reclassification had no impact on previously reported operating income, or net income.

NEW ACCOUNTING STANDARDS

In June 1998, the Financial Accounting Standards Board (FASB) issued Statement of Financial Accounting Standards No. 133, "Accounting for Derivative Instruments and Hedging Activities." Statement No. 133 will be effective for the Company beginning with the Company's fiscal year ending September 30, 2000. In July 1999, the FASB issued Statement of Financial Accounting Standards No. 137, "Accounting for Derivative Instruments and Hedging Activities - Deferral of the Effective Date of FASB Statement No. 133" which defers the effective date of FASB 133 to the Company's fiscal year ending September 30, 2001. As the Company presently has no derivative instruments and is not involved in hedging activity, the Company does not expect the adoption of FASB Statement No. 133 and FASB Statement No. 137 to have an impact on the results of operations or the financial position of the Company.

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

1. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (CONTINUED)

NEW ACCOUNTING STANDARDS (CONTINUED)

In January 1999, the American Institute of Certified Public Accountants issued Statement of Position No. 98-9 (SOP 98-9), "Modification of SOP 97-2, Software Revenue Recognition, with Respect to Certain Transactions." This SOP retains the limitations of SOP 97-2 on what constitutes vendor-specific objective evidence of fair value. SOP 98-9 will become effective for the Company's fiscal year ending September 30, 2000. The adoption of SOP 98-9 is not expected to have a significant impact on the results of operations or financial position of the Company.

In November 1999, the Staff of the Securities and Exchange Commission issued Staff Accounting Bulletin No. 100 (SAB 100) - Restructuring and Impairment Charges. This SAB expresses the views of the Staff regarding the accounting for and disclosure of certain expenses commonly reported in connection with exit activities and business combinations. Although it has not made a definite determination of its impact, the Company does not expect the adoption of SAB 100 to have a materially adverse effect on its financial position or results of operation.

In December 1999, the Staff of the Securities and Exchange Commission issued Staff Accounting Bulletin No. 101 (SAB 101) - Revenue Recognition in Financial Statements. This SAB summarizes certain of the Staff's views in applying generally accepted accounting principals to revenue recognition in financial statements. Although it has not made a definite determination of its impact, the Company does not expect the adoption of SAB 101 to have a materially adverse effect on its financial position or results of operation.

2. RESTATEMENT

After discussion with the staff of the Securities and Exchange Commission (the SEC) the consolidated financial statements as of September 30, 1998 and for the year ended September 30, 1998 have been restated to reflect a change in the measurement and allocations of the purchase prices related to the July 1998 acquisitions of ITK and CDC.

The Company allocated amounts to IPR&D and intangible assets in the fourth quarter of 1998 in a manner consistent with widely recognized appraisal practices at the date of the acquisitions of ITK and CDC. Subsequent to the acquisitions, the SEC staff expressed broad views that took issue with certain

appraisal practices generally employed by many public companies in determining the fair value of IPR&D. As a result of these developments, the Company has modified its valuation of IPR&D using the alternative income valuation approach. In addition, in response to questions raised by the SEC Staff about the Company's measurement of the fair value of common stock and common stock options issued in the ITK and CDC acquisitions, the Company has revised its valuation of this portion of the purchase prices.

As a result of valuing IPR&D using the alternative income valuation approach and adjusting the measurement of the purchase prices, the Company, in consultation with their independent accountants, has revised its measurement and allocations of the purchase prices, including the amounts allocated to IPR&D. The effect of these adjustments was to: reduce the aggregate amount originally allocated to IPR&D from \$39.2 million to \$16.1 million; increase the aggregate amount allocated to current

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

2. RESTATEMENT (CONTINUED)

technologies from \$15.0 to \$29.1 million; increase the amount of net deferred tax liabilities from \$0 to \$6.3 million; increase goodwill from \$8.2 million to \$27.4 million; increase additional paid in-capital from \$68.7 million to \$70.5 million; and reduce unearned stock compensation from \$3.8 million to \$1.7 million. These adjustments will also result in additional annual amortization expense related to identifiable intangibles and goodwill of approximately \$5.0 million (assuming there are no future adjustments to reflect impairments of such intangibles and goodwill). The revised purchase accounting for the ITK and CDC acquisitions is described in detail in Note 3.

The restatement does not affect previously reported net cash flows for the periods. The effect of this reallocation on previously reported consolidated financial statements as of and for the year ended September 30, 1998 is as follows:

	As of and for the year ended September 30, 1998	
	As previously reported	As restated
Statement of Operations Data:		
General and administrative expenses	\$ 16,003,146	\$ 17,011,504
Acquired in-process research and development	39,200,000	16,364,933
Total operating expenses	110,474,583	88,347,874
Operating (loss) income	(16,082,069)	6,344,640
Loss before income taxes	(12,913,783)	9,212,926
Provision for income taxes	9,745,088	9,284,020
Net loss	\$ (22,658,871)	\$ (71,094)
Net loss per common share, basic	\$ (1.65)	\$ (0.01)
Net loss per common share, assuming dilution	\$ (1.65)	\$ (0.01)
Balance Sheet Data:		
Intangible assets, net	\$ 31,354,483	\$ 63,602,435
Total assets	160,734,667	192,982,619
Net deferred income taxes		5,817,933
Total liabilities	65,914,103	71,732,034
Additional paid-in capital	68,695,448	70,461,123
Retained earnings	52,455,031	75,842,808
Unearned stock compensation	(3,777,204)	(1,700,635)
Total stockholders' equity	\$ 94,820,564	\$ 121,250,585

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

3. ACQUISITIONS

In July 1998, the Company acquired all of the outstanding common stock of ITK International, Inc. (ITK). The transaction was accounted for using the purchase method of accounting. Accordingly, the purchase price was allocated to the estimated fair value of assets acquired and liabilities assumed, including estimated restructuring and integration costs of \$3,484,000 (see Note 4).

Components of the purchase consideration, including related transaction costs, consist of \$14,767,154 in cash, the Company's common stock with a market value of \$12,501,183 and \$2,316,415 of replacement stock options issued by the Company to ITK option holders. The cash and the Company's common stock were issued in exchange for outstanding shares of ITK's common stock and the Company's stock options were issued in exchange for the outstanding ITK common stock options. The value of the Company's common stock issued was based on a per share value of approximately \$21.69, calculated as the average market price of the Company's common stock during the two business days immediately preceding and subsequent to the date the parties reached agreement on terms and announced the transaction. The value of the Company's common stock options is based on the estimated fair value of these options, as of the date the transaction was consummated, using the Black-Scholes valuation model.

The table below is an analysis of the purchase price allocation.

Cash and fair value of Company's common stock and common stock options issued	\$ 28,146,369
Direct acquisition costs	1,438,383
ITK liabilities assumed, including estimated Restructuring and integration costs of \$3,484,000	39,784,248

Total purchase price	\$ 69,369,000
	=====
Estimated fair value of tangible assets acquired, including \$5,772,000 of deferred taxes	27,440,814
Estimated fair value of:	
IPK&D	11,330,100
Identifiable intangible assets	21,100,000
Goodwill	17,727,086
Deferred tax liabilities related to identifiable intangibles	(8,229,000)

	\$ 69,369,000
	=====

The Company utilized the alternative income valuation approach to determine the estimated fair value of the purchased in-process research and development. Management estimates that \$11.3 million of the purchase price represents the fair value of purchased in-process research and development related to the VoIP projects referred to above, that had not yet reached technological feasibility and had no alternative future uses. These amounts were expensed as a non-recurring, non-tax-deductible charge upon consummation of the acquisition. It is not certain that development efforts on these projects will allow for carrier class telephone company and end-user specifications to be met. Failure to achieve these specifications or to achieve market viability will cause the in-process Voice over Internet Protocol technology (VoIP) projects to fail. If these products are not successfully developed, the sales and

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

3. ACQUISITIONS (CONTINUED)

profitability of the combined Company may be adversely affected in future periods. Additionally, the value of other identifiable intangible assets and goodwill acquired may become impaired.

The identifiable intangible assets of \$21,100,000 included in the purchase price allocation set forth above are comprised of proven technology with an estimated fair value of \$19,700,000 and an assembled workforce with an estimated fair

value of \$1,400,000, which have estimated useful lives of five years and six years, respectively. The remaining unallocated purchase price represents goodwill, which is being amortized over seven years.

In July 1998, the Company acquired all of the outstanding common stock of Central Data Corporation (CDC). The transaction was accounted for using the purchase method of accounting. Accordingly, the purchase price was allocated to the estimated fair value of assets acquired and liabilities assumed, including estimated restructuring and integration costs of \$750,000 (see Note 4).

Components of the purchase consideration, including related transaction costs, consist of \$14,261,965 in cash, the Company's common stock with a market value of \$4,326,721 and \$2,693,236 of replacement stock options issued by the Company to CDC option holders. The cash and the Company's common stock were issued in exchange for outstanding shares of CDC's common stock and the Company's stock options were issued in exchange for the outstanding CDC common stock options. The value of the Company's common stock issued was based on a per share value of approximately \$21.09, calculated as the average market price of the Company's common stock during the two business days immediately preceding and subsequent to the date the parties reached agreement on terms and announced the transaction. The value of the Company's common stock options is based on the estimated fair value of these options, as of the date the transaction was consummated, using the Black-Scholes valuation model.

The table below is an analysis of the purchase price allocation.

Cash and fair value of Company's common stock and common stock options issued	\$ 20,980,482
Direct acquisition costs	301,440
CDC liabilities assumed, including estimated restructuring and integration costs of \$750,000	4,394,617

Total purchase price	\$ 25,676,539
	=====
Estimated fair value of tangible assets acquired	5,252,408
Estimated fair value of:	
IPR&D	4,734,833
Identifiable intangible assets	9,800,000
Goodwill	9,711,298
Deferred tax liabilities related to identifiable intangibles	(3,822,000)

	\$ 25,676,539
	=====

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

3. ACQUISITIONS (CONTINUED)

The Company utilized the alternative income valuation approach to determine the estimated fair value of the purchased in-process research and development. Management estimates that \$4.7 million of the purchase price represents the fair value of purchased in-process research and development related to the USB projects referred to above, that had not yet reached technological feasibility and had no alternative future uses. These amounts were expensed as a non-recurring, non-tax-deductible charge upon consummation of the acquisition. It is not certain that development efforts on these projects will allow for user specifications to be met or commercial viability to be achieved. Failure to achieve these specifications or to achieve market viability will cause the Universal Serial Bus (USB) projects to fail. If these products are not successfully developed, the sales and profitability of the combined Company may be adversely affected in future periods. Additionally, the value of other identifiable intangible assets and goodwill acquired may become impaired.

The identifiable intangible assets of \$9,800,000 included in the purchase price allocation set forth above are comprised of proven technology with an estimated

fair value of \$9,400,000, and an assembled workforce with an estimated fair value of \$400,000, which have estimated useful lives of five years and six years, respectively. The remaining unallocated purchase price represents goodwill, which is being amortized over seven years.

The following unaudited pro forma condensed consolidated results of operations have been prepared as if the acquisitions of ITK and CDC had occurred as of the beginning of fiscal 1998 and 1997:

	1998	1997
Net sales	\$220,271,670	\$194,605,937
Net loss	(\$20,206,426)	(\$76,316,007)
Net loss per share	(\$1.36)	(\$5.39)

The unaudited pro forma condensed consolidated results of operations are not necessarily indicative of results that would have occurred had the acquisitions been in effect for the years presented, nor are they necessarily indicative of the results that will be obtained in the future.

4. RESTRUCTURING

In March 1999, the Company's Board of Directors approved a restructuring plan related to the reorganization of sales and marketing functions in Germany, England and the United States, by consolidating worldwide sales and marketing resources into strategic locations. The original related charge of \$1,452,909 (\$581,164 net of tax benefits) consisted of \$151,038 of existing commitments for rent on facilities vacated by the Company in Hamburg, Nurnberg, and Frankfurt, Germany and \$1,301,871 of termination payments associated with the elimination of 44 positions in Dortmund, Germany, Bagshot, England, Sunnyvale, California, and Minneapolis, Minnesota.

As of September 30, 1999, the Company paid \$836,953 of termination costs relating to the elimination of 33 positions. During the third quarter of fiscal 1999, management of the Company determined that \$33,100 of severance costs in Dortmund would not be payable due to a decision to retain two employees previously notified that they would be terminated. In addition, the Company reduced its estimated

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

4. RESTRUCTURING (CONTINUED)

remaining rent commitment by \$80,106 as it successfully sublet the vacated office space in Nurnberg, Germany. During the fourth quarter of fiscal 1999, management of the Company determined that \$160,114 of severance costs in Minneapolis would not be payable due to a decision to retain two additional employees previously notified that they would be terminated. Adjustments to the restructuring accrual are reflected as a reduction in the restructuring accrual and a corresponding increase to operating income. Management of the Company expects that these restructuring activities will be completed by December 1999. A summary of payments and adjustments is included in the table below.

Description	Beginning Balance	Payments	Change in Estimate Adjustments	Balance at September 30, 1999
Severance and termination costs	\$ 1,301,871	\$ (836,953)	\$ (193,214)	\$ 271,704
Rent commitments	151,038	(50,460)	(80,106)	20,472
TOTAL	\$ 1,452,909	\$ (887,413)	\$ (273,320)	\$ 292,176

In July 1998, the Company's Board of Directors approved a restructuring plan

related to the consolidation of its offices in Germany and England. The restructuring plan relates to the closure of existing leased facilities rendered redundant by the acquisition of ITK. The original charge of \$1,020,000 (\$647,000 net of tax benefits), consisted of \$61,483 of noncancellable rent commitments the Company expected to incur following closure of the Cologne, Germany facility, \$100,110 of contractual payment obligations for office furniture and other equipment the Company expected to incur following the closure of the Cologne, Germany facility, \$202,039 related to the write-off of leasehold improvements in connection with the closure of the Cologne, Germany facility and \$656,368 of termination payments associated with the elimination of six positions in Cologne, Germany and Bagshot, England.

The Company closed the Cologne facility during December 1998. As of September 30, 1999, the company paid \$301,044 of termination costs relating to the elimination of two positions. During the third quarter of 1999, the Company reduced the restructuring accrual by \$572,191 due to management's decision during the quarter to retain four employees previously notified that they would be terminated, a final settlement negotiated by the Company which reduced the remaining contractual rent commitments for office space and equipment in Cologne, Germany which was previously vacated and abandoned by the Company, and a decision by current management to utilize certain equipment which prior management had planned to abandon. Adjustments to the restructuring accrual are reflected as a reduction in the restructuring accrual and a corresponding increase to operating income. Restructuring activities have been completed as of June 1999. A summary of payments and adjustments is included in the table below.

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

4. RESTRUCTURING (CONTINUED)

Description	Balance at September 30, 1998	Payments	Change in Estimate Adjustments	Balance at September 30, 1999
Severance and termination costs	\$ 656,368	\$ (301,044)	\$ (355,324)	\$ -
Rent commitments	61,483	(29,900)	(16,374)	15,209
Contractual payments for office equipment	100,110	(49,972)	(50,138)	-
Write-offs of leasehold improvements	202,039	(14,358)	(150,309)	37,326
TOTAL	<u>\$ 1,020,000</u>	<u>\$ (395,274)</u>	<u>\$ (572,191)</u>	<u>\$ 50,535</u>

In connection with the Company's acquisition of ITK, the Company formulated a plan of reorganization and accordingly, has recognized a \$3,484,000 restructuring liability which the Company has included as a component of total liabilities assumed in the acquisition. Components of the original estimated liability included \$1,844,000 of termination payments associated with 10 employees the Company expected to eliminate at the Chelmsford, Massachusetts ITK location and 20 employees the Company expected to eliminate at the Dortmund, Germany location and \$1,640,000 of noncancellable rent obligations for facilities the Company expected to incur following closure of facilities in Chelmsford, Massachusetts and Bristol and Newbury, England.

The Company vacated the Chelmsford, Bristol, and Newbury facilities in March 1999, October 1998 and May 1999, respectively. During the third quarter of fiscal 1999, the Company reduced the restructuring accrual by \$1,451,882 as management determined during the quarter that the number of positions to be terminated was 26 rather than 30 due to unanticipated employee turnover and other changes in management of the Company during fiscal 1999. In addition, during the third quarter of 1999, the Company and the lessor of the Newbury facility reached a final, negotiated settlement which significantly reduced the Company's remaining contractual rent obligation. Adjustments to the restructuring accrual are reflected as a reduction in the restructuring accrual and a corresponding decrease in goodwill. Restructuring activities have been completed as of June 1999. A summary of payments and adjustments is included in the table below.

Description	Balance at September 30, 1998	Payments	Change in Estimate Adjustments	Balance at September 30, 1999
Severance and termination costs	\$ 1,644,000	\$ (1,442,339)	\$ (378,792)	\$ 22,869
Facility closures	1,640,000	(531,513)	(1,073,090)	35,397
TOTAL	\$ 3,484,000	\$ (1,973,852)	\$ (1,451,882)	\$ 58,266

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

4. RESTRUCTURING (CONTINUED)

In connection with the Company's acquisition of CDC, the Company formulated a plan of reorganization and accordingly, the Company has recognized a \$750,000 restructuring liability which the Company has included as a component of total liabilities assumed in the acquisition. Components of this estimated liability included \$675,000 of termination payments, associated with 22 employees the Company expected to eliminate when it closed the Champaign, Illinois facility in January 1999 and \$75,000 related to facility closure costs the Company expected to incur following closure and sale of the Champaign, Illinois facility.

During the third quarter of fiscal 1999, the Company reduced the restructuring accrual by \$222,513 due to management's decision during the quarter to reduce the number of employees to be terminated from 22 to 20 due to unanticipated employee turnover and other changes in management. In addition, during the third quarter, management determined that it would not incur significant additional closure costs from the sale of the Champaign, Illinois facility. Adjustments to the restructuring accrual are reflected as a reduction in the restructuring accrual and a corresponding decrease in goodwill. Restructuring activities have been completed as of June 1999. A summary of payments and adjustments is included in the table below.

Description	Balance at September 30, 1998	Payments	Change in Estimate Adjustments	Balance at September 30, 1999
Severance and Termination costs	\$ 675,000	\$ (442,166)	\$ (147,513)	\$ 85,321
Facility closure	75,000	-	(75,000)	-
TOTAL	\$ 750,000	\$ (442,166)	\$ (222,513)	\$ 85,321

In February 1997, the Company's Board of Directors approved a restructuring plan that resulted in a restructuring charge of \$10,471,482 (\$8,283,681, net of tax benefits). The corporate restructuring plan resulted in consolidation and reduced costs and expenses. It included the closing of the Cleveland manufacturing facility, the reduction of selected product lines and the consolidation and closing of the Torrance, California and Nashville, Tennessee research and development facilities. These costs included: (i) write downs of the carrying values of fixed assets related to the closed manufacturing and research and development facilities, (ii) write downs of the carrying values of goodwill and identifiable intangible assets (primarily licensing agreements related to the discontinued product lines) and related inventories, and (iii) severance costs associated with the elimination of 105 positions. These restructuring activities were completed in fiscal year 1997.

The restructuring charge consisted of \$1,259,769 in net cash expenditures (primarily severance), of which all had been paid as of September 30, 1997, and \$9,211,713 resulting from the write-down of asset carrying values.

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

5. SEGMENT INFORMATION AND MAJOR CUSTOMERS

The Company operates in one reportable segment as defined in FAS 131. The operations of the Company are primarily conducted in the United States, the Company's country of domicile. Geographic data, determined by references to the location of the Company's operations for the years ended September 30, are as follows:

Revenue by geographic area:

	Year Ended September 30,		
	1999	1998	1997
	----	----	----
United States	\$164,329,109	\$171,385,998	\$159,262,803
Europe	26,948,248	9,573,107	5,093,731
Asia	1,249,157	1,205,606	845,453
Australia	9,9545	768,959	395,950
	-----	-----	-----
	\$193,506,659	\$182,931,670	\$165,597,937
	=====	=====	=====

Long-lived assets by geographic area:

	Year Ended September 30,		
	1999	1998	1997
	----	----	----
United States	\$40,921,189	\$40,218,876	\$30,154,981
Foreign	37,125,699	49,374,482	339,308
	-----	-----	-----
Total long-lived assets	\$78,047,488	\$89,593,358	\$30,494,293
	-----	-----	-----

The Company's foreign export sales, primarily to Europe, comprised 34.8%, 25.5%, and 26.9% of net sales for the years ended September 30, 1999, 1998 and 1997, respectively.

During 1999, one customer accounted for 15.4% of net sales and 8.7% of the trade accounts receivable as of September 30, 1999, while another accounted for 13.4% of net sales and 22.5% of the trade accounts receivable as of September 30, 1999.

During 1998, one customer accounted for 15.5% of net sales and 26% of the trade accounts receivable as of September 30, 1998, while another accounted for 13.7% of net sales and 10% of the trade accounts receivable as of September 30, 1998.

During 1997, one customer accounted for 15.1% of net sales while another accounted for 10.5% of net sales. In addition, one customer accounted for 28% of the trade accounts receivable outstanding as of September 30, 1997.

6. INVESTMENT IN AETHERWORKS CORPORATION

In May 1998, the Company exchanged its previously purchased \$13,796,525 of convertible notes from AetherWorks Corporation, a development stage company engaged in the development of wireless and dial-up remote access technology, for a non-interest bearing \$8,000,000 non-convertible note. As a part of the exchange, the Company relinquished its rights to any future technology or claims on any of AetherWorks' intellectual properties. In exchange, the Company has been released from all of its

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

6. INVESTMENT IN AETHERWORKS CORPORATION (CONTINUED)

guarantees of certain lease obligations of AetherWorks. As a result, the Company has reversed its \$1,350,000 accrual established in the fourth quarter of 1997, for the estimated cost related to its guarantee of such lease obligations and has included such amount in AetherWorks Corporation gain for the year ended September 30, 1998.

Due to the significant uncertainty as to its collectibility, the \$8,000,000 note, which matures in 2001, has been recorded by the Company as having no carrying value.

The Company continues to lease to AetherWorks \$1,325,000 of computer equipment under a three-year direct financing lease, expiring in 2000.

For fiscal 1997, the Company reported its investment in AetherWorks on the equity method and reported net losses of \$5,764,201. This loss, which excludes \$5,738,548 of additional charges accrued as of September 30, 1997 as described below, represented 100% of AetherWorks net loss for the year. The percentage of AetherWorks net losses included in the Company's Statement of Operations was based upon the percentage of financial support provided by the Company (versus other investors) to AetherWorks that year.

Because of the significant uncertainty of the future of AetherWorks Corporation, as demonstrated by its lack of ability to generate positive cash flow, obtain other sources of equity financing and its continued uncertainty in developing commercially marketable products, the Company decided, as of September 30, 1997, to write off its remaining investment of \$2,408,548 in AetherWorks, and to accrue and expense its remaining obligation to purchase \$2,000,000 of additional notes. In addition, the Company also accrued \$1,350,000 for its obligation resulting from its guarantees of certain AetherWorks' lease obligations as of September 30, 1997.

The following represents condensed financial information from the audited statements of AetherWorks for the year ended September 30, 1997:

OPERATING DATA FOR THE YEAR ENDED SEPTEMBER 30, 1997

Operating expenses:	
Research and development	\$ 3,505,134
General and administrative	2,069,304
Other	1,169,345
Eliminations	(979,582)

Net loss	\$ (5,764,201)
	=====

The "eliminations line" item represents interest expense payable to the Company for interest due on the notes issued by AetherWorks to the Company. This amount is excluded from the AetherWorks loss as the Company has eliminated the corresponding interest income from its Consolidated Statements of Operations.

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

7. SELECTED BALANCE SHEET DATA

1999	1998
-----	-----
	As Restated-See

	Note 2	
Accounts receivable, net:		
Trade accounts receivable	\$42,720,227	\$53,618,657
Less reserve for returns and doubtful accounts and sales allowances	8,764,558	6,530,679
	<u>\$33,955,669</u>	<u>\$47,087,978</u>
Inventories, net:		
Raw materials	\$17,487,552	\$16,814,657
Work in process	2,162,626	2,922,442
Finished goods	7,335,755	10,735,483
	<u>26,985,933</u>	<u>30,472,582</u>
Less reserve for obsolescence	4,539,266	3,106,658
	<u>\$22,446,667</u>	<u>\$27,365,924</u>
Property, equipment and improvements:		
Land	\$ 2,533,666	\$ 2,774,300
Building	19,338,618	19,912,614
Improvements	580,286	554,932
Equipment	22,991,088	20,859,857
Purchased software	8,872,121	6,968,127
Furniture & fixtures	1,462,338	929,890
	<u>55,778,117</u>	<u>51,999,720</u>
Less accumulated depreciation	25,535,240	18,008,797
	<u>\$30,242,877</u>	<u>\$33,990,923</u>
Intangible assets:		
Purchased technology	\$30,010,858	\$30,010,858
License agreements	2,559,067	3,476,400
Assembled workforce	1,800,000	1,800,000
Other	1,228,225	1,483,835
Goodwill	29,826,194	33,802,679
	<u>65,424,344</u>	<u>70,573,772</u>
Less accumulated amortization	17,619,733	6,971,337
	<u>\$47,804,611</u>	<u>\$63,602,435</u>

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

8. BORROWING UNDER LINE OF CREDIT AGREEMENTS

The Company maintains lines of credit with various financial institutions which provide for borrowings of up to \$15,856,600. As of September 30, 1999 and 1998, \$4,759,095 and \$10,707,000 has been borrowed under these line of credit agreements. These line of credit agreements are uncollateralized and provide for interest rates ranging from 4.5% to 10.6% as of September 30, 1999 and 1998.

9. LONG-TERM DEBT

Long-term debt consists of the following at September 30,

	1999	1998
	----	----
5.5% fixed rate long-term collateralized note	\$1,688,260	\$ 1,854,490
5.2% fixed rate long-term collateralized note	1,143,660	1,256,240

6.3% fixed rate long-term collateralized note	4,356,800	4,764,959
6.0% fixed rate long-term uncollateralized note	1,960,360	1,555,010
5.0% to 10.6% subsidized long-term notes	386,666	525,851
6.0% fixed rate long-term collateralized note	-	538,450
Variable rate long-term collateralized note	-	250,000
Long-term collateralized mortgage note	-	623,471
	-----	-----
	\$9,535,946	\$11,388,471
Less current portion	330,028	264,025
	-----	-----
	\$9,205,918	\$11,124,446

The 5.5% fixed rate long-term note is payable in semi-annual installments beginning September 2000. The 5.2% fixed rate long-term note is payable in semi-annual installments beginning June 2001. The 6.3% fixed rate long-term note is payable in semi-annual installments beginning March 2000. Interest on the notes is payable on a quarterly basis. These notes are collateralized by land, buildings and equipment with a book value of \$9,228,990. The 6.0% fixed rate long-term uncollateralized note is due in full on November 30, 2001. Interest is payable annually.

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

9. LONG-TERM DEBT (CONTINUED)

The subsidized long-term notes bear interest rates ranging from 5% to 10.6% and are due at various dates through 2006. All borrowings under these notes are uncollateralized.

The 6.0% fixed rate long-term collateralized note, the variable rate long-term collateralized note, and the long-term collateralized mortgage note were paid in full during fiscal 1999.

Aggregate maturities of long-term debt are as follows:

Fiscal Year	
2000	\$ 330,028
2001	397,013
2002	1,838,570
2003	675,304
2004	422,610
Thereafter	5,872,421

	\$9,535,946

10. INCOME TAXES

The components of the provision for income taxes for the years ended September 30, 1999, 1998, and 1997 are as follows:

	1999	1998	1997
	----	----	----
Currently payable:			
Federal	\$ 6,201,277	\$ 9,768,927	\$ 1,737,116
State	705,378	766,704	142,457
Deferred	(2,119,056)	(1,251,611)	(1,787,933)
	-----	-----	-----
	\$ 4,787,599	\$ 9,284,020	\$ 91,640
	=====	=====	=====

The net deferred tax asset (liability) at September 30, 1999 and 1998 consists of the following:

	1999 ----	1998 ----
Valuation reserves	\$ 2,904,412	\$ 2,673,443
Inventory valuation	228,442	430,501
Compensation costs	600,991	1,007,367
Net operating loss carryforwards	5,772,000	5,772,000
Intangible asset basis difference	(9,203,133)	(11,589,933)
Other	154,854	102,133
	-----	-----
Net deferred tax asset (liability)	\$ 457,566	\$ (1,004,489)
	=====	=====

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

10. INCOME TAXES (CONTINUED)

As of September 30, 1999 and 1998, the net deferred tax asset (liability) consists of current deferred tax assets of \$3,888,699 and \$4,213,444, respectively and net non-current deferred tax liabilities of \$3,431,133 and \$5,817,933, respectively. As of September 30, 1999 and 1998, the Company has recorded \$9,203,133 and \$11,589,933 of deferred tax liabilities related to the identifiable intangible assets that were acquired as part of the ITK and CDC acquisitions. These deferred tax liabilities are being amortized over the estimated useful lives of the related identifiable intangible assets acquired.

As of September 30, 1999 and 1998, the Company had federal net operating loss carryforwards of approximately \$14,800,000 available to offset future taxable income, which expire at various dates through 2011. Utilization of such net operating loss carryforwards is presently limited to offset taxable income, if any, generated by ITK.

The reconciliation of the statutory federal income tax rate with the effective income tax rate for the years ended September 30, 1999, 1998, and 1997 is as follows:

	1999 -----	1998 -----	1997 -----
Statutory income tax rate	35.0%	35.0%	(34.0) %
Increase (reduction) resulting from:			
Utilization of research and development tax credits			(0.9)
Utilization of low income housing credits	(5.0)	(3.9)	1.7
State taxes, net of federal benefits	5.7	5.4	
AetherWorks Corporation net operating loss			12.5
AetherWorks Corporation write-off			9.6
Acquired in-process research and development		61.0	
Restructuring charges			9.3
Tax contingencies			4.7
Nondeductible intangible asset amortization	15.3	2.7	1.3
Foreign operations	2.9	5.4	(0.2)
Other	6.1	(4.8)	(3.9)
	-----	-----	-----
	60.0%	100.8%	0.1 %

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

11. STOCK OPTIONS AND EMPLOYEE STOCK PURCHASE PLAN

The Company's stock option plan (the Stock Option Plan) provides for the issuance of nonstatutory stock options and incentive stock options (ISOs) to key employees and nonemployee board members holding less than 5% of the outstanding shares of the Company's common stock. The Company's Non-Officer Stock Option Plan (the Non-Officer Plan and, together with the Stock Option Plan, the Plans), provides for the issuance of nonstatutory stock options to key employees who are not officers or directors of the Company.

The option price for ISOs and non-employee directors options granted under the Stock Option Plan is set at the fair market value of the Company's common stock on the date of grant. The option price for nonstatutory options granted under the Plans is set by the Compensation Committee of the Board of Directors. The authority to grant options under the Plans and set other terms and conditions rests with the Compensation Committee. The Stock Option Plan terminates in 2006. The Non-Officer Plan does not have a designated termination date.

During the years ended September 30, 1999, 1998, and 1997, 402,022, 287,882, and 50,106 shares of the Company's Common Stock, respectively, were issued upon the exercise of options for 402,022, 289,353, and 50,167 shares, respectively. The difference between shares issued and options exercised results from the provision in the Plans allowing employees to elect to pay their withholding obligation through share reduction. Withholding taxes paid by the Company as a result of the share withholding provision amounted to \$28,871 and \$5,171 during the years ended September 30, 1998 and 1997, respectively. No employees elected to pay tax withhold obligations through share reduction during fiscal 1999.

During the year ended September 30, 1998 the Board of Directors authorized the issuance of incentive stock options for the purchase of 486,631 shares. In addition, the Board of Directors authorized the issuance of nonstatutory stock options for the purchase of 543,461 shares, at prices below the market value of the stock on the grant dates.

During the year ended September 30, 1997 the Board of Directors authorized the cancellation and reissue of nonstatutory stock options to certain employees for the purchase of 823,326 shares, at an exercise price below the market value of the stock. Under this authorization, the original option issues were canceled and new options were issued with a new four-year vesting schedule.

The difference between the option price and market value at the date of grant for the above option arrangements has been recorded as additional paid-in capital with an offsetting debit within stockholders' equity to unearned stock compensation. The compensation expense related to these option grants is amortized to operations over the contractual vesting period in which employees perform services and amounted to \$582,981 in 1999, \$895,401 in 1998, and \$244,569 in 1997.

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

11. STOCK OPTIONS AND EMPLOYEE STOCK PURCHASE PLAN (CONTINUED)

Stock options and common shares reserved for grant under the Plans are as follows:

	Available For Grant	Options Outstanding	Weighted Average Price Per Share
	-----	-----	-----
Balances, September 30, 1996	354,514	2,336,660	\$ 18.14
Additional shares approved for grant	500,000		
Granted	(1,509,701)	1,509,701	8.62
Exercised		(50,617)	7.71
Cancelled	1,879,636	(1,879,636)	19.01
	-----	-----	
Balances, September 30, 1997	1,224,449	1,916,108	\$ 10.01

Additional shares approved for grant	750,000		
Granted	(1,254,525)	1,254,525	15.96
Exercised		(289,353)	8.56
Cancelled	150,013	(150,013)	12.79
	-----	-----	
Balances, September 30, 1998	869,937	2,731,267	\$ 12.75
Granted	(1,019,100)	1,019,100	9.32
Exercised		(402,022)	\$ 5.95
Cancelled	1,244,635	(1,244,635)	\$ 14.26
	-----	-----	
Balances, September 30, 1999	1,095,472	2,103,710	\$ 11.50
	-----	-----	

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

11. STOCK OPTIONS AND EMPLOYEE STOCK PURCHASE PLAN (CONTINUED)

Commencing April 1996, the Company has sponsored an Employee Stock Purchase Plan (the Purchase Plan) which covers all domestic employees with at least 90 days of service. The Purchase Plan allows eligible participants the right to purchase common stock on a quarterly basis at the lower of 85% of the market price at the beginning or end of each three-month offering period. Employee contributions to the plan were \$586,324 in 1999, \$658,118 in 1998, and \$534,327 in 1997. Pursuant to the Purchase Plan, 80,482, 37,398, and 69,402 shares were issued to employees during the fiscal years ended 1999, 1998 and 1997, respectively. As of September 30, 1999, 303,883 shares are available for future issuances under the Purchase Plan.

12. STOCK-BASED COMPENSATION

In accordance with Statement of Financial Accounting Standards No. 123, "Accounting for Stock-Based Compensation" (SFAS 123), the Company has chosen to continue to account for stock-based compensation using the intrinsic value method prescribed in Accounting Principles Board Opinion No. 25, "Accounting for Stock Issued to Employees," and related interpretations. Accordingly, compensation costs for stock options granted to employees are measured as the excess, if any, of the fair value of the Company's stock at the date of the grant over the amount an employee must pay to acquire the stock. Such compensation costs, if any, are amortized on a straight-line basis over the option vesting schedule.

Had the Company used the fair-value-based method of accounting for its stock options granted in 1999, 1998 and 1997, and charged operations over the option vesting periods based on the fair value of options at the date of grant, net income (loss) and net income (loss) per common share would have been changed to the following pro forma amounts:

	1999	1998	1997
	----	----	----
Net income (loss):			
As reported	\$ 3,191,733	\$ (71,094)	\$ (15,790,844)
Pro forma	\$ 281,852	\$ (3,244,655)	\$ (17,149,611)
Net income (loss) per share - basic:			
As reported	\$ 0.22	\$ (0.01)	\$ (1.18)
Pro forma	\$ 0.02	\$ (0.24)	\$ (1.30)
Net income (loss) per share - assuming dilution:			
As reported	\$ 0.22	\$ (0.01)	\$ (1.18)
Pro forma	\$ 0.02	\$ (0.24)	\$ (1.30)

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

12. STOCK-BASED COMPENSATION (CONTINUED)

The weighted average fair value of options granted in fiscal years 1999, 1998 and 1997 was \$11.50, \$12.29, and \$12.47, respectively. The weighted average fair value was determined based upon the fair value of each option on the grant date, utilizing the Black-Scholes option-pricing model and the following assumptions:

ASSUMPTIONS:	1999	1998	1997
-----	----	----	----
Risk free interest rate	5.75%	5.49%	6.02%
Expected option holding period	4 years	4 years	4 years
Expected volatility	50%	60%	40%
Expected dividend yield	0	0	0

At September 30, 1999, the weighted average exercise price and remaining life of the stock options are as follows:

RANGE OF EXERCISE PRICES	\$2.36 - 3.19	\$5.91 - 8.88	\$9.40 - 14.00	\$14.31 - 20.88	\$21.50 - 29.25	Total
-----	-----	-----	-----	-----	-----	-----
Total options outstanding	19,009	1,087,279	315,769	217,713	233,998	2,103,778
Weighted average remaining contractual life (years)	4.41	8.13	8.14	6.66	6.70	7.75
Weighted average exercise price	\$2.70	\$7.66	\$11.97	\$17.71	\$24.35	\$11.50
Options exercisable	39,734	386,927	171,339	116,187	107,592	893,379
Weighted average price of exercisable options	\$2.79	\$7.69	\$12.06	\$17.29	\$23.77	\$12.84

13. SHARE RIGHTS PLAN

The Company has adopted a share rights plan. Under the plan, the Company distributed as a dividend one right for each share of the Company's common stock outstanding on June 30, 1998. Each right entitles its holder to buy one one-hundredth of a share of a new series of junior participating preferred stock at an exercise price of \$115, subject to adjustment. The rights are exercisable only if certain ownership considerations are met. The Company will be entitled to redeem the rights prior to the rights becoming exercisable.

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

14. COMMITMENTS

The Company has entered into various operating lease agreements, the last of which expires in fiscal 2013. Below is a schedule of future minimum commitments under noncancellable operating leases:

FISCAL YEAR	AMOUNT
-----	-----
2000	\$ 1,224,904
2001	864,496
2002	411,944
2003	72,371
2004	72,371
Thereafter	\$ 663,399

Total rental expense for all operating leases for the years ended September 30, 1999, 1998 and 1997 was \$1,838,242, \$1,786,715, and \$1,405,582 respectively.

15. EMPLOYEE BENEFIT PLAN

The Company has a savings and profit sharing plan pursuant to Section 401(k) of the Internal Revenue Code ("the Code"), whereby eligible employees may contribute up to 15% of their pre-tax earnings, not to exceed amounts allowed under the Code. In addition, the Company may make contributions to the plan at the discretion of the Board of Directors. The Company accrued \$350,000 as a matching contribution for 1999. The Company provided a matching contribution of \$240,000 in 1998 and no Company contribution was made in 1997.

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

16. CONTINGENCIES

During fiscal 1997, the Company and certain of its previous officers were named as defendants in a series of putative securities class action lawsuits in the United States District Court for the District of Minnesota on behalf of an alleged class of purchasers of its common stock during the period January 25, 1996 through December 23, 1996, inclusive, which were consolidated, through a Consolidated Amended Complaint filed in May 1997. Also in 1997, a similar but separate action was filed by the Louisiana State Employees Retirement System. The Consolidated Amended Complaint and the Louisiana Amended Complaint allege the Company and certain of its previous officers violated federal securities laws by, among other things, misrepresenting and/or omitting material information concerning the Company's operations and financial results. The Louisiana Amended Complaint also alleges misrepresentations in violation of state common law.

In a decision issued on May 22, 1998, the District Court granted in part and denied in part the motions of the Company and its three former officers to dismiss the Consolidated Amended Complaint and the Louisiana Amended Complaint. The Court dismissed without leave to replead all claims asserted in both cases, except for certain federal securities law claims based upon alleged misrepresentations and/or omissions relating to the accounting treatment applied to the Company's AetherWorks investment. The Court also limited the claims asserted in the Louisiana Amended Complaint to the 11,000 shares of the Company's stock held subsequent to November 14, 1996. These claims remain pending against the Company and two of its former officers, Ervin F. Kamm, Jr. and Gerald A. Wall. Discovery in the actions is proceeding.

The 21 lead plaintiffs have moved for class certification with respect to the claims asserted in the Consolidated Amended Complaint. The Company and its former officers intend to oppose the motion. No date has been set for a hearing on the class certification motion. With the possible exception of additional depositions of certain lead plaintiffs, discovery in all of the actions has been completed.

The Company and its former officers served motions for summary judgment in all actions on November 19, 1999. Briefing on the motions is scheduled to be completed by February 4, 2000, and a hearing is expected to be held before the Court after that date.

The ultimate outcomes of these actions cannot be determined at this time, and no potential assessment of the probable or possible effects of such litigation if any, on the Company's financial position, liquidity or future operations can be made.

In the normal course of business, the Company is subject to various claims and litigation. Management of the Company expects that these various litigation items will not have a material adverse effect on the results of operations or financial condition of the Company.

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (CONTINUED)

17. FOURTH QUARTER FISCAL 1998 INFORMATION (UNAUDITED)

During the third quarter of fiscal year 1998, management of the Company established \$3 million of inventory valuation reserves including \$1 million

which related to an estimated overstatement of inventories resulting from certain system difficulties encountered in connection with the implementation of a new enterprise-wide computer system during the third quarter, and \$2 million which related to estimated adjustments to the value of certain remote access server products which the Company believed were approaching technological obsolescence, primarily due to the expected introduction of the Company's new remote access server products in the fourth quarter of fiscal year 1998.

During the fourth quarter the Company was advised by a third-party vendor that it would delay delivery of a new modem which was integral to the Company's planned introduction of its new remote access server products. When the Company became aware of this delay, management reassessed the estimated timing and effect of technological obsolescence on the value of its old remote access product inventories, which resulted in a \$900,000 reduction in the management's estimate of the required obsolescence provision in the fourth quarter.

In addition, in connection with its normal year-end closing procedures, the Company conducted a physical inventory count of its inventories as of September 30, 1998. This physical inventory count indicated that any previous inventory record discrepancies that had resulted from the system implementation were no longer impacting the Company's reported inventory balances as of September 30, 1998. Accordingly, the Company determined, during the fourth quarter, that the system difficulties encountered in the third quarter had been corrected and, therefore eliminated the related \$1 million provision during the fourth quarter.

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REPORT OF MANAGEMENT

TO THE STOCKHOLDERS OF DIGI INTERNATIONAL INC.

The Company's management is responsible for the integrity, objectivity and consistency of the financial information presented in this Annual Report on Form 10-K and the Company's 1999 Annual Report to Shareholders. The consolidated financial statements contained herein were prepared in accordance with generally accepted accounting principles and were based on informed judgments and management's best estimates as required. Financial information elsewhere in this annual report is consistent with that contained in the consolidated financial statements.

The Company maintains a system of internal controls designed to provide reasonable assurance that assets are safeguarded, transactions are properly executed in accordance with management's authorization, and accounting records may be relied upon for the preparation of financial statements and other financial information. The system is monitored by direct management review. Limitations exist in any system of internal control, based upon the recognition that the cost of the system should not exceed the benefits derived.

The Company's consolidated financial statements have been audited by PricewaterhouseCoopers LLP, independent certified public accountants. Their audit was conducted in accordance with generally accepted auditing standards. As part of their audits of the Company's consolidated financial statements, these independent accountants considered the Company's internal controls to the extent they deemed necessary to determine the nature, timing and extent of their audit tests.

The Audit Committee of the Board of Directors is composed entirely of non-employee directors and is responsible for monitoring and overseeing the quality of the Company's accounting and reporting policies, internal controls and other matters deemed appropriate. The independent certified public accountants have free access to the Audit Committee without management present.

/s/ John P. Schinas

John P. Schinas
Chairman

/s/ Subramanian Krishnan

Subramanian Krishnan
Senior Vice President and Chief Financial Officer

December 28, 1999

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REPORT OF INDEPENDENT ACCOUNTANTS

TO THE STOCKHOLDERS AND BOARD OF DIRECTORS OF DIGI INTERNATIONAL INC.

In our opinion, the accompanying consolidated balance sheets and the related consolidated statements of operations, cash flows and stockholders' equity present fairly, in all material respects, the financial position of Digi International Inc. and subsidiaries (the Company) at September 30, 1999 and 1998, and the results of their operations and their cash flows for each of the three years in the period ended September 30, 1999, in conformity with generally accepted accounting principles. These financial statements are the responsibility of the Company's management; our responsibility is to express an opinion on these financial statements based on our audits. We conducted our audits of these statements in accordance with generally accepted auditing standards which require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements, assessing the accounting principles used and significant estimates made by management, and evaluating the overall financial statement presentation. We believe that our audits provide a reasonable basis for the opinion expressed above.

As discussed more fully in Note 2, the Company and the staff of the Securities and Exchange Commission have had discussions regarding the accounting treatment related to the July 1998 acquisitions of ITK International, Inc. and Central Data Corporation. As a result of these discussions, the Company has changed the method used to allocate the purchase price to in-process technologies. In connection with this modification, the Company has adjusted the measurement and allocations of the purchase prices recorded for the aforementioned acquisitions. Accordingly, the consolidated financial statements as of and for the year ended September 30, 1998 have been restated.

As discussed in Note 6, the Company has recorded its investment in AetherWorks Corporation (AetherWorks) on the equity method; the 1997 consolidated statement of operations include AetherWorks' net operating loss for the year ended September 30, 1997 of \$5,764,201. We did not audit the financial statements of AetherWorks, which statements were audited by other auditors whose report has been furnished to us, and our opinion, insofar as it relates to the amounts included for AetherWorks' net operating loss, is based solely on the report of other auditors.

/s/ PricewaterhouseCoopers LLP
Minneapolis, Minnesota
December 15, 1999

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QUARTERLY FINANCIAL DATA (UNAUDITED)

In thousands except per share amounts	Quarter ended			
	Dec. 31	Mar. 31	June 30	Sept. 30
1999				
Revenues	\$51,355	\$47,631	\$51,745	\$48,335
Gross margin	26,451	18,478	27,147	26,076
Restructuring		1,453	(885)	(761)
Net income (Loss)	475	(2,351)	2,353	2,715
Net income (Loss) per share - basic	0.03	-0.15	0.15	0.18
Net income (Loss) per share - assuming dilution	0.03	-0.15	0.15	0.16
1998 (a)				
Revenues	\$42,550	\$45,059	\$46,449	\$48,833
Gross margin	21,369	25,066	24,759 (b)	25,399 (b)
Acquired in-process research and development				16,065
Restructuring				1,020
AetherWorks Corporation gain			1,350	
Net income (Loss)	3,842	4,665	6,421	(14,989)
Net income (Loss) per share - basic	0.28	0.35	0.47	(1.05)

Net income (Loss) per share - assuming dilution	0.27	0.33	0.45	(1.05)
1997				
Net sales	\$42,286	\$40,893	\$40,813	\$42,125
Gross margin	19,540	19,294	20,118	21,063
Restructuring		16,471		
NetAcWorks Corporation net loss	(1,120)	(1,180)	(1,125)	(1,130)
AcquisiWorks Corporation write-off				(5,759)
Net (loss) income	(2,578)	(9,400)	7	(2,431)
Net (loss) income per share - basic	(0.19)	(0.70)	0.01	(0.29)
Net (loss) income per share - assuming dilution	(0.19)	(0.70)	0.01	(0.29)

The summation of quarterly net income per share may not equate to the year-end calculation as quarterly calculations are performed on a discrete basis.

(a) see Note 2 to the Company's consolidated financial statements.

(b) see Note 17 to the Company's consolidated financial statements.

ITEM 9. CHANGES IN AND DISAGREEMENTS WITH ACCOUNTANTS ON ACCOUNTING AND FINANCIAL DISCLOSURE.

None.

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PART III

ITEM 10. EXECUTIVE OFFICERS OF THE REGISTRANT

As of the date of filing this Form 10-K, the following individuals were executive officers of the Registrant:

Name	Age	Position
Joseph T. Dunsmore	41	President and Chief Executive Officer
Douglas J. Glader	56	Executive Vice President and Chief Operating Officer
Subramanian Krishnan	45	Senior Vice President and Chief Financial Officer

Mr. Dunsmore joined the Company on October 24, 1999, as President and Chief Executive Officer and as a member of the Board of Directors. Prior to joining Digl International, Mr. Dunsmore had been Vice President of Access for Lucent Microelectronics, a telecommunications company, since July 1999. From October 1998 to June 1999, he acted as an independent consultant to various high technology companies. From February 1998 to October 1998, Mr. Dunsmore was Chief Executive Officer of NetFax, Inc., a telecommunications company. From October 1995 to February 1998, he held executive management positions at US Robotics and then at 3COM after 3COM acquired US Robotics in June 1997. Prior to that, Mr. Dunsmore held various marketing management positions at AT&T Paradyne Corporation since May 1983.

Mr. Glader was named Executive Vice President and Chief Operating Officer on April 19, 1999, Vice President of Operations in February 1995 and Senior Vice President, Manufacturing Operations, on April 23, 1997. Before that, he was Director of Manufacturing and Operations for MiLAN Technology Corporation, which the Company acquired in November 1993. He began his career with Memorex Corporation and also worked for Measurex Corporation, Altus Corporation and Direct Incorporated. He founded and was Vice President of Operations for Greyhawk Systems, Inc., a manufacturer of electronic imaging hardware and software.

Mr. Krishnan was named Senior Vice President and Chief Financial Officer on February 1, 1999. Prior to joining the Company, he served as a principal with LAWCO Financial, an investment banking firm in Minneapolis, MN from January 1997 to January 1999. Prior to LAWCO, he served for 13 years with the Valspar Corporation as the Director of Corporate Financial Planning and Reporting and Taxes and was primarily responsible for mergers, acquisitions and joint

ventures.

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PART IV

ITEM 14. EXHIBITS, FINANCIAL STATEMENT SCHEDULES AND REPORTS ON FORM 8-K

- (a) Consolidated Financial Statements and Schedules of the Company and Report of Independent Auditors for AetherWorks Corporation
 - 1. Consolidated Statements of Operations for the fiscal years ended September 30, 1999, 1998 and 1997
 - Consolidated Balance Sheets as of September 30, 1999 and 1998
 - Consolidated Statements of Cash Flows for the fiscal years ended September 30, 1999, 1998 and 1997
 - Consolidated Statements of Stockholders' Equity for the fiscal years ended September 30, 1999, 1998 and 1997
 - Notes to Consolidated Financial Statements
 - Report of Independent Accountants
 - 2. All financial statement schedules are omitted because they are not applicable or are not required.
 - 3. Report of Ernst & Young LLP, Independent Auditors for AetherWorks Corporation
- (b) Reports on Form 8-K
 - Form 8-K/A dated August 18, 1999, regarding the Company's acquisition of ITK International, Inc. on July 29, 1998.

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ITEM 14. EXHIBITS, FINANCIAL STATEMENT SCHEDULES AND REPORTS ON FORM 8-K (CONTINUED)

- (c) Exhibits

Exhibit Number	Description
-----	-----
3(a)	Restated Certificate of Incorporation of the Company (1)
3(b)	Amended and Restated By-Laws of the Company (2)
4(a)	Form of Rights Agreement, dated as of June 10, 1998 between Digi International Inc. and Norwest Bank Minnesota, National Association, as Rights Agent (3)
4(b)	Amendment dated January 26, 1999, to Share Rights Agreement, dated as of June 10, 1998 between Digi International Inc. and Norwest Bank Minnesota, National Association, as Rights Agent (4)
10(a)	Stock Option Plan of the Company (5)
10(b)	Form of indemnification agreement with directors and officers of the Company (6)
10(c)	Amended and Restated Employment Agreement between the

Company and John P. Schinas (7)

10(d) Restated and Amended Note Purchase Agreement between the Company and AetherWorks Corporation, dated May 12, 1998

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ITEM 14. EXHIBITS, FINANCIAL STATEMENT SCHEDULES AND REPORTS ON FORM 8-K (CONTINUED)

(c) Exhibits (Continued)

Exhibit Number	Description
10(e)	Employment Arrangement between the Company and Jonathon E. Killmer, dated September 16, 1996 *(8)
10(f)	Employment Agreement between the Company and Jerry A. Dusa, dated March 12, 1997 *(9)
10(g)	Employment Arrangement between the Company and Douglas Glader *(10)
10(g)(i)	Amendment to Employment Agreement between the Company and Douglas Glader, dated September 24, 1999
10(h)	Employment Agreement between the Company and Dino G. Kasdagly, dated October 1, 1997 *(11)
10(i)	Agreement between the Company and Subramanian Krishnan dated March 26, 1999 *(12)
10(i)(i)	Amendment to Agreement between the Company and Subramanian Krishnan dated September 24, 1999 *
10(j)	Employment Agreement between the Company and Joseph T. Dunsmore dated October 24, 1999 *
10(k)	Employee Stock Purchase Plan of the Company (13)
13	1999 Annual Report to Stockholders (only those portions specifically incorporated by reference herein shall be deemed filed with the Securities and Exchange Commission)
21	Subsidiaries of the Company
23.1	Consent of Independent Accountants
23.2	Consent of Independent Accountants
24	Powers of Attorney
27	Financial Data Schedule

*Management contract or compensatory plan or arrangement required to be filed as an exhibit to this Form 10-K.

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ITEM 14. EXHIBITS, FINANCIAL STATEMENT SCHEDULES AND REPORTS ON FORM 8-K (CONTINUED)

(1) Incorporated by reference to Exhibit 3(a) to the Company's Form 10-K for

the year ended September 30, 1993 (File no. 0-17972).

- (2) Incorporated by reference to Exhibit 3(b) to the Company's Registration Statement on Form S-1 (File no. 33-42384).
- (3) Incorporated by reference of Exhibit 1 to the Company's Registration Statement on Form 8-A dated June 24, 1998 (File no. 0-17972).
- (4) Incorporated by reference to Exhibit 1 to Amendment No. 1 to the Company's Registration Statement on Form 8-A dated February 5, 1999 (File no. 0-17972).
- (5) Incorporated by reference to the corresponding exhibit number to the Company's Form 10-K for the year ended September 30, 1998 (File no. 0-17972).
- (6) Incorporated by reference to Exhibit 10(b) to the Company's Registration Statement on Form S-1 (File no. 33-30725).
- (7) Incorporated by reference to Exhibit 10(c) to the Company's Form 10-K for the year ended September 30, 1994 (File no. 0-17972).
- (8) Incorporated by reference to Exhibit 10(k) to the Company's Form 10-K/A for the year ended September 30, 1996 (File no. 0-17972).
- (9) Incorporated by reference to Exhibit 10(m) to the Company's Form 10-Q for the quarter ended March 31, 1997 (File no. 0-17972).
- (10) Incorporated by reference to Exhibit 10(q) to the Company's Form 10-K for the year ended September 30, 1995 (File no. 0-17972).
- (11) Incorporated by reference to Exhibit 10(r) to the Company's Form 10-K for the year ended September 30, 1997 (File no. 0-17972).
- (12) Incorporated by reference to Exhibit 10(k) to the Company's Form 10-Q for the quarter ended March 31, 1999 (File no. 0-17972).
- (13) Incorporated by reference to Exhibit B to the Company's Proxy Statement for its Annual Meeting of Stockholders held on January 31, 1996.

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REPORT OF INDEPENDENT AUDITORS

BOARD OF DIRECTORS AND SHAREHOLDERS AETHERWORKS CORPORATION

We have audited the balance sheets of AetherWorks Corporation (a development stage company) as of September 30, 1997 and 1996, and the related statements of operations, shareholders' equity (deficit) and cash flows for the years then ended and the period from February 24, 1993 (inception) to September 30, 1997. These financial statements, not separately presented herein, are the responsibility of the Company's management. Our responsibility is to express an opinion on these financial statements based on our audits.

We conducted our audits in accordance with generally accepted auditing standards. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. We believe that our audits provide a reasonable basis for our opinion.

In our opinion, the financial statements referred to above present fairly, in all material respects, the financial position of AetherWorks Corporation (a development stage company) at September 30, 1997 and 1996, and the results of its operations and its cash flows for the years then ended and the period from February 24, 1993 (inception) to September 30, 1997, in conformity with generally accepted accounting principles.

The financial statements referred to above have been prepared assuming the Company will continue as a going concern. As discussed in Note 11 to the

financial statements, the Company's deficit accumulated during the development stage raises substantial doubt about its ability to continue as a going concern. The Company intends to obtain additional financing to permit it to continue its operations. The financial statements do not include any adjustments that might result from the outcome of this uncertainty.

/s/ Ernst & Young LLP

Minneapolis, MN
October 28, 1997

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SIGNATURES

Pursuant to the requirements of Section 13 or 15(d) of the Securities Exchange Act of 1934, the Registrant has duly caused this report to be signed on its behalf by the undersigned, thereunto duly authorized.

DIGI INTERNATIONAL INC.

December 28, 1999

By: /s/ Joseph T. Dunsmore

Joseph T. Dunsmore
President and Chief Executive Officer

Pursuant to the requirements of the Securities Exchange Act of 1934, this report has been signed below by the following persons on behalf of the Registrant and in the capacities and on the dates indicated.

December 28, 1999

/s/ Joseph T. Dunsmore

Joseph T. Dunsmore
President and Chief Executive Officer
(Principal Executive Officer)

December 28, 1999

/s/ Subramanian Krishnan

Subramanian Krishnan
Sr. Vice President & Chief Financial Officer
(Principal Financial and Accounting Officer)

JOHN P. SCHINAS
WILLIS K. DRAKE
RICHARD E. EICHHORN
MYKOLA MOROZ
DAVID STANLEY
ROBERT S. MOE
KENNETH E. MILLARD
JOSEPH T. DUNSMORE

A majority of the Board of Directors⁴

Subramanian Krishnan, by signing his name hereto, does hereby sign this document on behalf of each of the above named directors of the Registrant pursuant to Powers of Attorney duly executed by such persons.

December 28, 1999

/s/ Subramanian Krishnan

Subramanian Krishnan
Attorney-in-fact

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EXHIBIT INDEX

Exhibit -----	Description -----	Page ----
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10(a)	Stock Option Plan of the Registrant	Incorporated by Reference
10(b)	Form of indemnification agreement with directors and officers of the Registrant	Incorporated by Reference
10(c)	Amended and Restated Employment Agreement between the Registrant and John P. Schinas	Incorporated by Reference
10(d)	Restated and Amended Note Purchase Agreement between the Registrant and AetherWorks Corporation, dated May 12, 1998	Filed Electronically
10(e)	Employment Arrangement between the Registrant and Jonathon E. Killmer, dated September 16, 1996	Incorporated by Reference
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10(g)(i)	Amendment to Employment Agreement between the Registrant and Douglas Glader, dated September 24, 1999	Filed Electronically
10(h)	Employment Agreement between the Registrant and Dino G. Kasdagly, dated October 1, 1997	Incorporated by Reference
10(i)	Agreement between the Company and Subramanian Krishnan dated March 26, 1999.	Incorporated by Reference
10(i)(i)	Amendment to the agreement between the Company and Subramanian Krishnan dated September 24, 1999.	Filed Electronically
10(j)	Employment Agreement between the Company and Joseph T. Dunsmore, dated October 24, 1999	Filed Electronically
10(k)	Employee Stock Purchase Plan of the Registrant	Incorporated by Reference
13	1999 Annual Report to Stockholders	Filed Electronically
21	Subsidiaries of the Company	Filed Electronically
23.1	Consent of Independent Accountants	Filed Electronically
23.2	Consent of Independent Accountants	Filed Electronically
24	Powers of Attorney	Filed Electronically
27	Financial Data Schedule	Filed Electronically

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EXHIBIT 10(d)

AETHERWORKS CORPORATION
1998 NOTE PURCHASE AGREEMENT

This Agreement is made and entered into as of May 12, 1998 by and between AetherWorks Corporation, a Minnesota corporation (the "Company") and Digi International Inc., a Delaware corporation ("Digi"), sometimes referred to individually as a "Party" and collectively as the "Parties."

WHEREAS, On or about October 14, 1997 the Parties entered into the following agreements: 1997 Note Purchase Agreement, Note A, Note B, 1997 Shareholder Voting Agreement, 1997 Security Agreement, and Co-Sale Agreement (collectively, referred to herein as the "1997 Agreements"); and

WHEREAS, On or about September 12, 1997, the Parties entered into an Equipment Lease; and

WHEREAS, In order to facilitate a restructuring of the debt, and other rights and responsibilities contemplated by the 1997 Agreements;

NOW THEREFORE, in consideration of the foregoing premises and the Parties' other rights and obligations set forth in this Agreement, the Parties hereby agree as follows:

1. Rescission of Certain Agreements; Releases

The 1997 Note Purchase Agreement, 1997 Shareholder Voting Agreement, and Co-Sale Agreement are hereby rescinded and shall be of no further force or effect. Each Party hereby releases the other Party, and each of its officers, directors and employees, from any obligations and all causes of action that are owed now or may arise in the future.

2. Amendment and Restatement of Certain Agreements and Instruments

2.1 Note A and Note B shall be amended and restated by issuance of a new note to Digi dated May 12, 1998 (the "1998 Note"), in the amount of Eight Million Dollars (\$8,000,000) in the form of Exhibit 1, which shall fully satisfy the Company's obligations under Note A and Note B.

2.2 In the event the 1998 Note is lost, stolen or destroyed, and upon receipt of evidence of that fact and a bond of indemnity, reasonably satisfactory to the Company, the Company will issue a replacement note to Digi.

2.3 The Equipment Lease shall be amended and restated in the form of Exhibit 2 and shall be known as the "Amended and Restated Equipment Lease."

2.4 The 1997 Security Agreement shall be amended and restated in the form of Exhibit 3, and shall be known as the "1998 Amended and Restated Security Agreement." On or prior to the Closing Date, the Company and Digi agree to (i) terminate all documents and filings made in connection with the 1997 Security Agreement, (ii) execute all documents deemed necessary to release Digi's security interest in the collateral thereunder, and (iii) file all documents and filings necessary to perfect Digi's security interest in the Collateral as defined in the 1998 Amended and Restated Security

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Agreement and Amended and Restated Equipment Lease, in form and substance mutually satisfactory to the Parties.

3. Release of Certain Guarantees

3.1 Schedule A attached hereto, includes a complete and correct list of all indebtedness, leases and other liabilities and obligation of the Company which have been previously guaranteed by Digi as of the date of

this Agreement.

3.2 Digi shall be released by the Company from its obligation under the 1997 Documents to guarantee the obligation of the Company to Carlton Corporation, Koll Real Estate Company, and Central Computer Systems Inc.

3.3 In the case of the Company's obligations to Sanwa Leasing Corporation, Digi's guarantee shall remain in place, but shall be subordinated to the guarantee of a third party mutually agreed upon by the Parties (the "Third Party").

4. Non Competition Agreement

An Agreement (the "Non Competition Agreement") in the form of Exhibit 4, shall be executed by Jonathan A. Sachs on or before the execution of this Agreement.

5. Closing

The closing of the issuance of the 1998 Note by the Company to Digi and execution and exchange of other relevant documents to the satisfaction of the Parties, shall occur at the offices of Digi on May 12, 1998 (the "Closing Date"). At the Closing, the Company will deliver to Digi the executed 1998 Note, the Non Competition Agreement, and an executed agreement between the Company and Third Party, expressly assuming the guarantees defined in paragraph 3 above. At the Closing, Digi will deliver the 1997 Note Purchase Agreement, 1997 Shareholder Voting Agreement, 1997 Co-Sale Agreement for rescission and cancellation, as well as Note A and Note B, and partial releases for all previous UCCs, documents and other filings made in connection with the 1995 and 1997 Security Agreements.

6. Conditions to Closing

6.1 The representations and warranties of the Company in Section 7 shall be true in all material respects as of the Closing Date.

6.2 All registrations and qualifications required under applicable state securities laws for the lawful execution and delivery of this Agreement, and the offer, sale, issuance and delivery of the 1998 Note shall have been obtained.

6.3 Jonathan A. Sachs shall have entered into the Non Competition Agreement.

6.4 Concurrent with the execution of this Agreement, the Company will execute an agreement with Third Party providing for at least \$5,000,000 over 9 months, contingent

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upon the occurrence of certain events, with at least \$1,000,000 payable immediately to Company.

7. Representations and Warranties by Company

Except as disclosed in Schedule A hereto, the Company and its officers represent and warrant to Digi that:

7.1 The Company is a corporation duly organized, validly existing and in good standing under the laws of Minnesota. The Company has the requisite corporate power and authority to issue the 1998 Note and otherwise perform its obligations under this Agreement.

7.2 To the best of the Company's knowledge, except as contemplated by this Agreement, neither the execution nor delivery of this Agreement will result in any breach of, or constitute a default under, or result in the imposition of any lien or encumbrance upon any asset or property of the Company, pursuant to any applicable law, judgment, order or decree, or other instrument to which the Company is a party or by which it or any of its properties or assets or rights is bound or affected.

7.3 No consent, authorization, approval or filing with any governmental authority is required in connection with the execution and delivery of this Agreement and the offer, issuance, or delivery of the 1998 Note, other than the qualification, if required, under applicable state securities laws, which qualification has been or will be effected as a condition of this sale. Based on the advice of the Company's counsel, the 1998 Note will not under current laws and regulations require compliance with the prospectus delivery or registration requirements of the Securities Act of 1933, as amended (the Securities Act").

7.4 This Agreement has been duly authorized by all necessary corporate action on behalf of the Company, and has been duly executed and delivered by authorized officers of the Company. This Agreement is a valid and binding Agreement of the Company, enforceable in accordance with its terms.

7.5 Except as disclosed on Schedule A, there are not any legal actions pending against the Company.

7.6 The Company will provide Digi as much advance written notice as is possible in the event the Corporation expects to cease doing business as a going concern or expects to file voluntarily, or have filed against it involuntarily a petition for relief under the federal Bankruptcy Code.

8. Representations and Warranties of Digi

Digi and its officers represent and warrant to the Company that:

8.1 The 1998 Note is being purchased for Digi's own account and not with the view to, or for resale in connection with, any distribution or public offering within the meaning of the Securities Act.

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8.2 Digi qualifies as an accredited investor under the Securities Act. Digi has such knowledge and experience in financial and business matters that Digi is capable of evaluating the merits and risks of the investment to be made hereunder by Digi.

8.3 Digi has had access to all of the Company's material books and records, and access to the Company's executive officers has been regularly provided to Digi.

8.4 This Agreement has been duly authorized by all necessary corporate action on behalf of Digi, and has been duly executed and delivered by authorized officers of Digi. This Agreement is a valid and binding Agreement of Digi, enforceable in accordance with its terms.

8.5 Digi agrees that it will make no public announcement or disclosure of any kind which identifies the name of Third Party.

9. Restriction of Transfer of Securities

The 1998 Note is transferable only pursuant to an effective registration under the Securities Act or an exemption therefrom and shall be endorsed with a restrictive legend to that effect.

10. Miscellaneous

10.1 Any modification or amendment of any provision of this Agreement must be in writing and signed by both of the Parties.

10.2 Neither this Agreement, nor any of the rights or obligations hereunder, shall be assignable without the prior written consent of the other Party.

10.3 The laws of Minnesota shall govern the validity of this Agreement.

IN WITNESS WHEREOF, the Parties have executed this Agreement as of the date first above written.

DIGI INTERNATIONAL INC.

By: /s/ Jerry A. Dusa

Name: Jerry A. Dusa
Its: President and CEO

AETHERWORKS CORPORATION

By: /s/Jonathan A. Sachs

Name: Jonathan A. Sachs
Its: President and CEO

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Exhibit 10(g)(i)

September 24, 1999

PERSONAL AND CONFIDENTIAL

Mr. Douglas J. Glader
Digi International Inc.
11001 Bren Road East
Minnetonka, MN 55343

Dear Doug:

This letter confirms the terms of an amendment to your employment agreement with the Company dated February 6, 1995, as previously amended by letter agreement dated January 16, 1997 (the "Agreement"). Except as specifically provided for herein, the terms of the Agreement remain in full force and effect.

If you are terminated by the Company without "cause" on or before September 30, 2000, you would be entitled to severance equal to one year's base salary and a bonus (if earned) that would be pro-rated for the portion of the fiscal year through the termination date. The definition of "cause" is attached as an appendix to the Agreement. Neither this letter nor the Agreement shall be construed so as to amend the definition of "cause" contained in the terms and conditions of your options to purchase shares of the Company's Common Stock.

The Agreement as amended by this letter constitutes the entire agreement between you and the Company regarding the subject matter contained therein and supersedes all prior agreements and understandings relating thereto.

If the terms outlined above are acceptable, please confirm by signing the enclosed copy below and returning it to me.

Very truly yours,
DIGI INTERNATIONAL INC.

/s/ John P. Schinas

By John P. Schinas
Chairman of the Board

ACCEPTED:

/s/ Douglas J. Glader

Douglas J. Glader

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Exhibit 10(i)(i)

September 24, 1999

PERSONAL AND CONFIDENTIAL
Mr. Subramanian Krishnan
Digi International Inc.
11001 Bren Road East
Minnetonka, MN 55343

Dear Kris:

This letter confirms the terms of an amendment to your severance agreement with the Company as set forth in the letter agreement dated March 26, 1999 (the "Agreement"). Except as specifically provided for herein, the terms of the Agreement remain in full force and effect.

If you are terminated by the Company without "cause" on or before September 30, 2000, you would be entitled to severance equal to one year's base salary and a bonus (if earned), based on your cash bonus target that would be pro-rated for the portion of the fiscal year through the termination date.

The Agreement as amended by this letter constitutes the entire agreement between you and the Company regarding the subject matter contained therein and supersedes all prior agreements and understandings relating thereto.

If the terms outlined above are acceptable, please confirm by signing the enclosed copy below and returning it to me.

Very truly yours,
DIGI INTERNATIONAL INC.

/s/ John P. Schinas

By John P. Schinas
Chairman of the Board

ACCEPTED:

/s/ Subramanian Krishnan

Subramanian Krishnan

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EXHIBIT 10(J)

EMPLOYMENT AGREEMENT
(Joseph T. Dunsmore)

This Agreement is made as of October 24, 1999 by and between DIGI INTERNATIONAL INC., a Delaware corporation (the "Company"), and Joseph T. Dunsmore (the "Executive").

WHEREAS the Company desires to employ Executive in accordance with the terms and conditions stated in this Agreement; and

WHEREAS Executive desires to accept that employment pursuant to the terms and conditions of this Agreement;

NOW THEREFORE, in consideration of the covenants and agreements contained herein, the parties hereto agree as follows:

I. EMPLOYMENT

1.1 Employment As Senior Executive. The Company hereby agrees to employ Executive, commencing the date hereof and continuing until the date his employment terminates pursuant to Article III hereof, in a senior executive capacity, initially as President and Chief Executive Officer of the Company. Executive accepts such employment pursuant to the terms of this Agreement. Executive shall perform such duties and responsibilities as may be determined from time to time by the Board of Directors of the Company, which shall be consistent with his position as a senior officer of the Company.

1.2 Exclusive Services. Commencing on the date hereof, Executive agrees to devote his full time, attention and energy to performing his duties and responsibilities to the Company under this Agreement, subject to a reasonable period, not to exceed four weeks, for transition from his former employment.

1.3 Vice Chairman; Chairman of the Board; Board Membership. The Company agrees that, no later than the next regularly scheduled Board meeting occurring on or after the date six months from the date hereof, the Board of Directors will consider electing Executive to the additional office of Vice Chairman. The Company agrees that, no later than the next regularly scheduled Board meeting occurring on or after the second anniversary of the date hereof, the Board of Directors will consider electing Executive to the additional office of Chairman of the Board. Concurrently with execution of this Agreement Executive has been elected a director of the Company.

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II. COMPENSATION, BENEFITS AND PERQUISITES

2.1 Base Salary. During the period this Agreement is in effect, the Company shall pay Executive a base salary at the annual rate of \$260,000, payable semi-monthly; provided, however, that Executive shall be paid a base salary at the annual rate of \$125,000, payable semi-monthly, until he assumes his duties on a full-time basis. Beginning on or about October 1, 2000, the Board of Directors of the Company (the "Board", which term shall include a duly authorized committee of the Board of Directors) will review the base salary annually, and may in its sole discretion increase it to reflect performance and other factors. However, the Board is not obligated to provide for any increases.

2.2 Bonuses. Beginning with the fiscal year ending September 30, 2001, Executive shall be eligible to receive a cash performance bonus of up to 100% base salary paid for each fiscal year during which this Agreement is in effect, as follows:

(a) Executive shall be entitled to the target bonus amount if the objectives set by the Board of Directors in its sole discretion for the fiscal year are met. Such objectives may include, in the sole discretion of the Board, the achievement of financial objectives set

forth in the Board-approved business plan (the "Business Plan") for a particular fiscal year, or such other objectives as the Board, in its sole discretion, shall determine.

(b) If some or all of the objectives are not met for a fiscal year, then the Board will determine in its discretion what portion, if any, of the target bonus amount will be paid to Executive for that year.

(c) The target bonus for each fiscal year shall be paid to Executive on September 30 of each year or as soon thereafter as the Company determines whether the objectives for such bonus have been met for that year.

(d) In any fiscal year in which the objectives for the cash bonus are based upon financial objectives in the Board-approved Business Plan for such fiscal year, the Board will consult with Executive before determining the Business Plan for each fiscal year. However, the Board will have authority to establish the Business Plan for each year in its sole discretion.

(e) In any fiscal year in which the objectives for the cash bonus are based upon financial objectives in the Board-approved Business Plan for such fiscal year, the objectives set by the Company's Board-approved Business Plan for such fiscal year shall not be adjusted for the acquisition, by any means, of any businesses or business units (and expenses related thereto) that may occur during a particular fiscal year. The objectives set by the Company's Board-approved Business Plan for any such fiscal year shall be equitably adjusted by the Board for the divestiture, by any

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means, of any businesses or business units (and expenses related thereto) that may occur during a particular fiscal year and to eliminate any reorganization, restructuring or other extraordinary charge that may be incurred during a particular fiscal year.

2.3 Bonus for Fiscal 2000. Executive shall be eligible to receive a guaranteed cash bonus of \$260,000 (prorated for the portion of the fiscal year from the date hereof to September 30, 2000) payable as follows:

- (a) \$110,000, promptly upon request of Executive, and
- (b) the balance on September 30, 2000.

In the event that Executive's employment with the Company terminates before September 30, 2000 except as a result of a termination by the Company other than for "cause" (as hereinafter defined), Executive shall not be entitled to any cash bonus for fiscal 2000 and shall promptly repay the \$110,000 (net of any tax withholding) to be advanced to him.

2.4 Overachievement Bonuses. If the objectives set by the Board of Directors for a cash performance bonus are exceeded for a fiscal year, the Board may in its discretion award Executive a bonus that is larger than the target bonus.

2.5 Stock Options. As of the date of this Agreement, Executive has been awarded an incentive stock option and a non-statutory stock option under the Dig: International Inc. Stock Option Plan (the "Stock Option Plan") for an aggregate of 240,000 Common Shares of the Company (as defined in the Stock Option Plan), on the terms set forth on Schedule I. On or about September 30 of each year the Compensation Committee of the Board of the Company considers and awards stock options to key employees of the Company and its subsidiaries. These awards are made in the discretion of the Compensation Committee and are principally intended to recognize performance over the preceding fiscal year.

2.6 Form of Stock Option Agreement. Stock option awards to Executive shall be pursuant to stock option agreements in substantially the form of Schedule II and III, with such additions thereto and deletions therefrom as Executive and the Chairman of the Board, the Chairman of the Compensation Committee or another duly authorized officer of the Company shall agree, such agreement to be conclusively evidenced by their execution and delivery thereof.

2.7 Vacations. Executive shall be entitled to vacation in accordance with policies of the Company.

2.8 Employee Benefits. Executive shall be entitled to the benefits and perquisites which the Company generally provides to its other senior executives under the applicable

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Company plans and policies, and to future benefits and perquisites made generally available to senior executives of the Company. Executive's participation in such benefit plans shall be on the same basis as applies to other senior executives of the Company. Executive shall pay any contributions which are generally required of senior executives to receive any such benefits.

2.9 Employment Taxes and Withholding. Executive recognizes that the compensation, benefits and other amounts provided by the Company under this Agreement may be subject to federal, state or local income taxes. It is expressly understood and agreed that all such taxes shall be the responsibility of the Executive. To the extent that federal, state or local law requires withholding of taxes on compensation, benefits or other amounts provided under this Agreement, the Company shall withhold the necessary amounts from the amounts payable to Executive under this Agreement.

2.10 Company Responsibility for Insured Benefits. In this Article II, the Company is agreeing to provide certain benefits which are provided in the form of premiums of insurance coverage. The Company is not itself promising to pay the benefit an insurance company is obligated to pay under the policy the insurance company has issued. If an insurance company becomes insolvent and cannot pay benefits it owes to Executive or his beneficiaries under the insurance policy, neither Executive nor his personal representative or beneficiary shall have any claim for benefits against the Company. The insurance companies presently providing such benefits are as set forth in the Company's benefits enrollment booklet previously delivered to Executive. In addition, the Company presently provides \$500,000 of term life insurance to senior executives through First Colonial Life Insurance Company and director and officer liability coverage, with a \$10 million policy limit, through Zurich Insurance Company.

2.11 Expenses. During the term of his employment hereunder, Executive shall be entitled to receive prompt reimbursement from the Company (in accordance with the policies and procedures in effect for the Company's employees) for all reasonable travel and other expenses incurred by him in connection with his services hereunder.

2.12 Relocation. Executive shall relocate to the general vicinity of the Minneapolis/St. Paul metropolitan area. The Company will (i) pay for Executive's direct relocation expenses, including the cost of moving Executive's household goods, in accordance with the provisions of the Company's relocation policies and practices for senior executives, and, (ii) as promptly as practicable, accept conveyance of Executive's residence located at 11 Wyckoff Road, Hampton, New Jersey, subject to review and acceptance of title, and, as consideration for such conveyance, pay Executive (or if applicable, Executive and his spouse) his documented purchase price for such residence, with the proceeds of sale applied first to discharge Executive's mortgage, and the balance paid to Executive (or if applicable, Executive and his spouse) in cash.

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2.13 Payment of Amounts Related to Previous Employment. The Company acknowledges that, because the Executive has accepted employment with the Company, he may be required to repay certain amounts to his previous employer, all of which amounts are specifically itemized on Schedule IV attached to this Agreement. As to each amount listed on Schedule IV, after the Executive's previous employer requires the Executive to repay such amount and after the Executive provides suitable documentation to the Company of his previous employer's position regarding such repayment, the Company shall promptly pay such amount to the Executive, together with an additional amount of cash sufficient to pay any personal income tax payable as a result of the Company's payments to Executive under this Section 2.13.

III. TERMINATION OF EXECUTIVE'S EMPLOYMENT

3.1 Termination of Employment. Executive's employment under this Agreement may be terminated by the Company at any time for any reason; provided, however, that if Executive's employment is terminated by the Company during the term of this Agreement for a reason other than for cause, he shall be entitled to continue to receive his base salary under Section 2.1 (i) for a period of 24 months from his date of termination in the event of termination on or before 6 months of the date hereof, (ii) for a period of 18 months from his date of termination in the event of termination after 6 months and on or before one year from the date hereof, and (iii) for a period of 12 months from his date of termination in the event of termination after one year from the date hereof. Executive's employment under this Agreement may be terminated by Executive at any time for any reason. The termination shall be effective as of the date specified by the party initiating the termination in a written notice delivered to the other party, which date shall not be earlier than the date such notice is delivered to the other party. Except as expressly provided to the contrary in this section or applicable law, Executive's rights to pay and benefits shall cease on the date his employment under this Agreement terminates. This Agreement shall terminate in its entirety immediately upon the death of Executive. In no event shall the Company's election not to extend the term of this Agreement pursuant to Section 5.11 be deemed to be termination by the Company for a reason other than cause.

3.2 Cause. For purposes of this Article III, "cause" shall mean only the following: (i) indictment or conviction of, or a plea of nolo contendere to, (A) any felony (other than any felony arising out of negligence), or any misdemeanor involving moral turpitude with respect to the Company, or (B) any crime or offense involving dishonesty with respect to the Company; (ii) theft or embezzlement of Company property or commission of similar acts involving dishonesty or moral turpitude; (iii) repeated material negligence in the performance of Executive's duties after notice; (iv) Executive's failure to devote substantially all of his working time and efforts during normal business hours to the Company's business; (v) knowing engagement in conduct which is materially injurious to the Company; (vi) knowing failure, for Executive's own benefit, to comply with the covenants contained in Sections 4.1 or 4.2 of this Agreement; (vii) knowingly providing materially misleading information

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concerning the Company to the Company's Board of Directors, any governmental body or regulatory agency or to any lender or other financing source or proposed financing source of the Company; or (viii) failure of the Company to meet at least 70% of the Board-approved Business Plan for either net sales or after tax earnings in any fiscal year, calculated in accordance with Section 2.2.

3.3 Disability. If Executive has become disabled from substantially performing his duties under this Agreement and the disability has continued for a period of more than ninety (90) days, the Board may, in its discretion, determine that Executive will not return to work and terminate his employment under this Agreement. Upon any such termination for disability, Executive shall be entitled to such disability, medical, life insurance, and other benefits as may be provided generally for disabled employees of the Company during the period he remains disabled.

3.4 Resignation. Executive agrees that, upon termination of Executive's employment hereunder for any reason, he shall be deemed to have resigned as a director of the Company and as a director, officer and/or employee of any parent company of the Company or any of their subsidiaries, unless prior to termination of Executive's employment hereunder the provisions of this Section 3.4 shall have been waived by vote of the Board (excluding Executive).

IV. NON-COMPETITION, CONFIDENTIALITY AND TRADE SECRETS

4.1 Agreement Not to Compete. In consideration of the covenants and agreements contained in this Agreement, Executive agrees that, on or before the date which is one year after the date Executive's employment by the Company, any parent company of the Company or any of their subsidiaries terminates, he will not, unless he receives the prior approval of the Board of Directors of the Company, directly or indirectly engage in any of the following actions:

- (a) Own an interest in (except as provided below), manage, operate, join, control, lend money or render financial or other assistance to, or participate in or be connected with, as an officer, employee, partner, stockholder, consultant or otherwise, any entity whose products or services compete with those of the Company, any parent

company of the Company, or any of their subsidiaries. However, nothing in this subsection (a) shall preclude Executive from holding less than one percent of the outstanding capital stock of any corporation required to file periodic reports with the Securities and Exchange Commission under Section 13 or 15(d) of the Securities Exchange Act of 1934, as amended, the securities of which are listed on any securities exchange, quoted on the Nasdaq National Market or Nasdaq SmallCap Market or traded in the over-the-counter market.

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(b) Intentionally solicit, endeavor to entice away from the Company, any parent company of the Company or any of their subsidiaries, or otherwise interfere with the relationship of the Company, any parent company of the Company or any of their subsidiaries with, any person who is employed by or otherwise engaged to perform services for the Company, any parent company of the Company or any of their subsidiaries (including, but not limited to, any independent sales representatives or organizations), or any persons or entity who is, or was within the then most recent 12-month period, a customer or client of the Company, any parent company of the Company or any of their subsidiaries, whether for Executive's own account or for the account of any other individual, partnership, firm, corporation or other business organization.

If the scope of the restrictions in this section are determined by a court of competent jurisdiction to be too broad to permit enforcement of such restrictions to their full extent, then such restrictions shall be construed or rewritten (blue-lined) so as to be enforceable to the maximum extent permitted by law, and Executive hereby consents, to the extent he may lawfully do so, to the judicial modification of the scope of such restrictions in any proceeding brought to enforce them.

4.2 Non-Disclosure of Information. During the period of his employment hereunder, and at all times thereafter, Executive shall not, without the written consent of the Board of Directors, disclose to any person, other than an employee of the Company, any parent company of the Company or any of their subsidiaries or a person to whom disclosure is reasonably necessary or appropriate in connection with the performance by Executive of his duties as an executive of the Company, except where such disclosure may be required by law, any material confidential information obtained by him while in the employ of the Company, any parent company of the Company or any of their subsidiaries with respect to any products, technology, know-how or the like, services, customers, methods or future plans of the Company, any parent company of the Company or any of their subsidiaries, all of which Executive acknowledges are valuable, special and unique assets, the disclosure of which Executive acknowledges may be materially damaging.

4.3 Remedies. Executive acknowledges that the Company's remedy at law for any breach or threatened breach by Executive of Section 4.1 or Section 4.2 will be inadequate. Therefore, the Company shall be entitled to injunctive and other equitable relief restraining Executive from violating those requirements, in addition to any other remedies that may be available to the Company under this Agreement or applicable law.

4.4 Proprietary Information and Employment Limitations. Executive agrees that no trade secret or proprietary information belonging to his previous employers will be disclosed or used by him at the Company, and that no such information, whether in the form of documents, memoranda, software, drawings, etc. will be retained by him or brought with him to the Company. Executive represents and warrants to the Company that he has brought

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to the Company's attention and provided it with a copy of any agreement which may impact his future employment by the Company, including non-disclosure, non-competition, invention assignment agreements or agreements containing future work restrictions, and that he is subject to no restrictions under any agreement of this type that would impact his employment by the Company.

V. MISCELLANEOUS

5.1 Amendment. This Agreement may be amended only in writing, signed by

both parties and approved by the Board.

5.2 Entire Agreement. Before signing this Agreement the parties had numerous conversations, including preliminary discussions, formal negotiations and informal conversations, and generated correspondence and other writings, in which the parties discussed the employment which is the subject of this Agreement and their aspirations for its success. In such conversations and writings, individuals representing the parties may have expressed their judgments and beliefs concerning the intentions, capabilities and practices of the parties, and may have forecasted future events. The parties recognize that such conversations and writings often involve an effort by both sides to be positive and optimistic about the prospects for the employment. It is also recognized, however, that all business transactions contain an element of risk, and that it is normal business practice to limit the legal obligations of contracting parties to only those promises and representations which are essential to their transaction so as to provide certainty as to their respective future rights and remedies. Accordingly, this Agreement is intended to define the full extent of the legally enforceable undertakings of the parties hereto, and no related promise or representation, written or oral, which is not set forth explicitly in this Agreement is intended by either party to be legally binding. Both parties acknowledge that in deciding to enter into this transaction they have relied on no representations, written or oral, other than those explicitly set forth in this Agreement. Executive has relied entirely on his own judgment and that of his advisers in entering into this Agreement.

5.3 Assignment. The Company may in its sole discretion assign this Agreement to any entity which succeeds to some or all of the business of the Company through merger, consolidation, a sale of some or all of the assets of the Company, or any similar transaction. Executive acknowledges that the services to be rendered by him are unique and personal. Accordingly, Executive may not assign any of his rights or obligations under this Agreement.

5.4 Successors. Subject to Section 5.3, the provisions of this Agreement shall be binding upon the parties hereto, upon any successor to or assign of the Company, and upon Executive's heirs and the personal representative of Executive or Executive's estate.

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5.5 Notices. Any notice required to be given under this Agreement shall be in writing and shall be delivered either in person or by certified or registered mail, return receipt requested. Any notice by mail shall be addressed as follows:

If to the Company, to:

Digi International Inc.
11001 Bren Road East
Minnetonka, MN 55343

Attention: Chairman of the Board

With a copy to:

Paegre & Benson LLP
2200 Norwest Center
90 South Seventh Street
Minneapolis, MN 55402-3601
Attention: James E. Nicholson

If to Executive, to:

Joseph T. Dunsmore
Digi International Inc.
11001 Bren Road East
Minnetonka, MN 55343

or to such other addresses as either party may designate in writing to the other party from time to time.

5.6 Waiver of Breach. Any waiver by either party of compliance with any provision of this Agreement by the other party shall not operate or be construed as a waiver of any other provision of this Agreement, or of any subsequent

breach by such party of a provision of this Agreement. No waiver by the Company shall be valid unless in writing and signed by the Chairman of the Board of Directors or Chairman of the Compensation Committee.

5.7 Severability. If any one or more of the provisions (or portions thereof) of this Agreement shall for any reason be held by a final determination of a court of competent jurisdiction to be invalid, illegal, or unenforceable in any respect, such invalidity, illegality or unenforceability shall not affect any other provisions (or portions of the provisions) of this Agreement, and the invalid, illegal or unenforceable provisions shall be deemed replaced by

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a provision that is valid, legal and enforceable and that comes closest to expressing the intention of the parties hereto.

5.8 Governing Law. THIS AGREEMENT SHALL BE INTERPRETED AND ENFORCED IN ACCORDANCE WITH THE LAWS OF THE STATE OF MINNESOTA, APPLICABLE TO CONTRACTS EXECUTED AND FULLY PERFORMED WITHIN THE STATE OF MINNESOTA WITHOUT GIVING EFFECT TO CONFLICT OF LAW PRINCIPLES. EXECUTIVE HEREBY IRREVOCABLY SUBMITS TO THE JURISDICTION OF ANY MINNESOTA STATE OR FEDERAL COURT IN ANY ACTION OR PROCEEDING ARISING OUT OF OR RELATING TO THIS AGREEMENT, AND THE COMPANY AND EXECUTIVE HEREBY IRREVOCABLY AGREE THAT ALL CLAIMS IN RESPECT OF SUCH ACTION OR PROCEEDING MAY BE HEARD AND DETERMINED ONLY IN SUCH MINNESOTA STATE COURT OR SUCH FEDERAL COURT AND IN NO OTHER COURT. EXECUTIVE HEREBY IRREVOCABLY WAIVES, TO THE FULLEST EXTENT HE MAY EFFECTIVELY DO SO, THE DEFENSE OF AN INCONVENIENT FORUM TO THE MAINTENANCE OF SUCH ACTION OR PROCEEDING. EACH OF THE COMPANY AND EXECUTIVE HEREBY IRREVOCABLY CONSENTS TO THE SERVICE OF COPIES OF THE SUMMONS AND COMPLAINT AND ANY OTHER PROCESS WHICH MAY BE SERVED IN ANY SUCH ACTION OR PROCEEDING BY CERTIFIED MAIL, RETURN RECEIPT REQUESTED, OR BY DELIVERING OF A COPY OF SUCH PROCESS TO OF THE COMPANY OR EXECUTIVE, AS THE CASE MAY BE, AT THE RESPECTIVE ADDRESS SPECIFIED IN SECTION 5.5 OR BY ANY OTHER METHOD PROVIDED BY LAW. EACH OF THE COMPANY AND EXECUTIVE AGREES THAT A FINAL JUDGMENT IN ANY SUCH ACTION OR PROCEEDING SHALL BE CONCLUSIVE AND MAY BE ENFORCED IN OTHER JURISDICTIONS BY SUIT ON THE JUDGMENT OR BY ANY OTHER MANNER PROVIDED BY LAW.

5.9 Headings. The headings of articles and sections herein are included solely for convenience and reference and shall not control the meaning or interpretation of any of the provisions of this Agreement.

5.10 Counterparts. This Agreement may be executed by either of the parties hereto in counterparts, each of which shall be deemed to be an original, but all such counterparts shall constitute a single instrument.

5.11 Automatic Renewal. Unless terminated at an earlier date in accordance with Section 3.1, the term of the Executive's employment with the Company hereunder shall be for the period commencing on the date hereof and ending on September 30, 2001. Unless terminated at an earlier date in accordance with Section 3.1, on each September 30, beginning September 30, 2000 (the "Renewal Date"), the term of the Executive's employment with the Company shall be automatically extended for successive two-year

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periods, unless either party gives written notice to the other party at least 60 days prior to the next Renewal Date that such party elects not to extend the term of this Agreement.

IN WITNESS WHEREOF, the parties have executed this Agreement in Minnetonka, Minnesota, effective as of the date set forth above.

DIGI INTERNATIONAL INC.

By /s/ John P. Schinas

Its Chairman of the Board

EXECUTIVE

/s/ Joseph T. Dunsmore

Joseph T. Dunsmore

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1999 ANNUAL REPORT

DIGI INTERNATIONAL INC.'s product line includes the most used communications adapter boards for server-based-systems. We have the products and partnerships to succeed in today's computing environment.

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Digi international (Nasdaq: DGII) is the world's leading supplier of multi-function adapters for server-powered communications. Digi's products, including its DataFire(R) digital adapters and AccelePort(R) multi-port serial adapters, are an integral part of server-based communications systems for applications such as point of sale, remote access, fax, routing, computer telephony and Internet access.

Server-based communications solutions are a growing market, and offer several advantages over competitive solutions based on stand-alone proprietary boxes. These include low cost of ownership; increased flexibility and scalability; dependability and simplified training and support. Server-based solutions also offer channel partners the ability to add value and increase profits by using industry-leading standard PC servers, operating systems and best-of-breed software applications.

Digi sells and markets its products through a global network of distributors, integrators, resellers and OEMs. The company maintains strong development and marketing partnerships with industry-leading hardware, software and operating system vendors. Digi also has a customer base that includes many of the world's largest companies, including IBM, AT&T, Siemens and others.

Digi is based in Minnetonka, Minnesota, and employs more than 575 people worldwide.

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This annual report, including the data set forth below, should be read in conjunction with Digi International Inc.'s Annual Report on Form 10-K for the year ended September 30, 1999, which includes Digi's financial statements, notes thereto and other information regarding the Company.

financial highlights

	1999	1998	1997	1996	1995
Net sales	\$ 193,506	\$ 182,932	\$ 165,598	\$ 193,131	\$ 161,978
Acquired in-process research and development		16,665			
Restructuring	607	1,720	13,472		
AccheNetworks Corporation net operating loss			(5,761)	(2,621)	
NethePort Corporation gain (write-off)		1,350		(5,739)	
Income (loss) before taxes	7,479	9,213	(15,694)	16,665	29,366
Net income (loss)	3,192	(71)	(15,791)	9,500	19,331
Net income (loss) per share - basic	0.22	(0.01)	(1.18)	0.78	1.42
Net income (loss) per share - assuming dilution	0.22	(0.01)	(1.18)	0.68	1.39
Weighted average shares outstanding - basic	14,711	13,733	13,393	13,326	13,606
Weighted average shares outstanding - assuming dilution	14,831	13,733	13,393	13,382	13,907
Working capital	\$ 39,846	\$ 37,886	\$ 41,979	\$ 48,646	\$ 74,961
Total assets	176,320	131,521	119,311	129,939	126,943
Stockholders' equity	127,164	121,251	95,471	129,943	105,827

Book value per share	8.52	8.84	7.69	8.94	7.89
Number of employees	583	709	481	608	605

(In thousands except per share amounts, percentages and number of employees)

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To Our Stockholders

In July 1998, Digi completed the acquisition of two companies: ITK in Dortmund, Germany and Central Data in Champaign, Illinois. The strategy for fiscal 1999 was to enhance our seasoned serial port and LAN businesses and achieve significant market share in new high growth markets such as remote access and Internet telephony. The idea was to leverage the USB products of Central Data to spur sales in the serial port business and to exploit ITK's VoIP technology, allowing Digi to enter new high growth markets. Unusual circumstances dictated that this was not to be in fiscal 1999. Because of situations that emerged along the way, I would characterize fiscal 1999 as three distinct phases: change, stabilization and growth.

Phase I Change: By the onset of fiscal 1999, the process of integrating these entities into the Digi culture was in progress. The Central Data integration was moving along nicely, and by the end of January 1999, was virtually complete. However, at the end of the first quarter, the integration of ITK was still moving slowly and aggravated by the departure of essential ITK employees. Expenses in Europe were at extraordinary levels, and ITK was losing ground in the fields of ISDN and VoIP. This situation was further complicated by the abrupt resignation of our CEO, Jerry Dusa, and an SEC inquiry questioning the \$39.2 million IPR&D write-off in connection with the acquisitions of Central Data and ITK. An ongoing IRS audit on the capitalization of R&D expenses for 1993, 1994 and 1995 added to the list of problems needing prompt attention.

Phase II stabilization: In early February, Kris Krishnan, Doug Glader and I formed a team to stabilize the situation and operate the company until a new CEO could be recruited. Gene Olsen was hired as Chief Technical Officer, and Jon Nyland took over as Vice President of Manufacturing Operations. The first mission was to complete the ITK integration, downsize the organization in Europe and, in general, reduce overall expenses. About the same time, it was discovered that our domestic distributor channel was at an uncomfortable inventory level, clearly an untenable situation. By the end of March 1999, the following was accomplished:

- ITK was integrated into Digi GmbH and expenses were under control.
- Head count was reduced, and redundant facilities were closed.
- The distributor sales channel inventory was lowered to below normal levels.

By the end of the third quarter, corporate expenses were back to traditional levels, and the SEC's IPR&D inquiry along with the IRS audit were negotiated and settled.

Phase III Growth: Next, the team's attention focused on product development. An essential part of Digi's ongoing business is dependent on the new DataFire RAS product line. Many important OEMs requested evaluation units and it was essential to ensure strong support from the company. To this end, a large segment of the engineering department was mobilized to provide fast corrective response to any defects these customers encountered. After several months of

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intense testing, companies like IBM took their first shipments of DataFire in September for deployment with their AS400s. Other customers for this product include Tropico (the Brazilian telephone company) and the South African Telco, a clear validation of our technology.

By fiscal year-end, our Sunnyvale operation was stabilized. All of Digi's European operations were consolidated into one company, Digi GmbH

headquartered in Dortmund, Germany. The engineering team, located in Dortmund, upgraded the NetBlazer 8500, which has led to increased sales activity for the ISDN and VoIP products. These are all positive signs for the future.

FINANCIAL ACCOMPLISHMENTS: At the beginning of February 1999, cash was at about \$5 million and Digi's stock was about \$6 per share. On September 30, cash exceeded \$34 million and the stock was at about \$14 per share, a definitive increase in shareholder value. Despite a tumultuous year, revenue grew 6 percent. Earnings were somewhat distorted due to the amortization costs associated with the two acquisitions and the resulting high effective tax rate. However, our operating income is a strong indicator of our success. These results leave the company well-positioned financially going forward.

The real strength of Digi International lies in the accomplishments of our employees. Their talent and commitment are vital to our future. During this period, our middle management stepped up to handle some difficult tasks. Special thanks go to Bill Lohse, Brian O'Rourke and Joe Toste. Clearly, the company has demonstrated that it can recover from the most adverse circumstances and emerge stronger and more confident to take on the future. Also, we thank Willis Drake, who is stepping down from the board of directors, for his many years of service and his contributions to Digi.

With our newly elected CEO Joe Dunsmore at the helm, I am confident that our company is in capable hands. Joe brings the market experience and determination to accelerate the growth of Digi International.

John P. Schinas
December 10, 1999

Joe Dunsmore Newly named CEO

"I watched Digi for nine months before coming on board. This company plays in a large and dynamic industry. There are no limits to our opportunities. What I think I can add is defining which track to take for growth, followed by solid execution. To do that, I'm spending the first 90 days on the road with our sales people and customers. At this point, I know we will leverage our experience in the small to medium-size business segment, and I'm excited about what we're pursuing in the open server and remote access markets."

Dunsmore's prior industry experience includes 17 years in executive management, product management, marketing positions and operations management at Lucent Microelectronics, 3Com and AT&T Paradyne.

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[TECHNOLOGY. Digi's new communications products pack unprecedented connectivity into a standards-based server, handling functions once performed by separate modems and CSU/DSUs. Digi's DataFire family of digital adapters provides the widest compatibility and most powerful performance available, concentrating eight to 60 channels in a single PCI or CompactPCI slot, while supporting up to ISDN and T1/E1 connections. AccelePort RAS multi-modem adapters integrate four or eight channels in a single PCI slot at analog speeds to 56 Kbps/V.90+. Both product lines use digital signal processor (DSP) technology, resulting in the industry's highest density of on-board modems for a RAS concentrator.]

With the explosion of digital commerce, computer networks are fundamental to business every day, and those networks are increasingly built from standard components from multiple vendors. The rate of change of these systems to serve Internet and e-business initiatives demands distributed, modular and interoperable components. These market needs have not only validated the concept of server-based solutions, but have vastly broadened the available applications for them.

[Our products are the leading brand choice within our distribution channel.]

Digi has the products and partnerships to succeed in this environment. For example, our DataFire product line is the most advanced communications adapter for Windows NT communications applications. Server-based communications have grown from simple multiuser connections ... to bulletin board systems...to remote access servers. Today, server-based systems support enterprise-wide and carrier-class communications systems. And these applications span all market categories in such capacities as Internet gateways, intranets, extranets, sales force automation, customer relationship management, call centers and unified

messaging.

[Chart. Digi's Digital Server-Based Market Share is 32%, Source: International Data Corporation, 1998.]

Open, server-based systems continue to prevail over closed proprietary systems due to their lower costs of ownership. In fact, Gartner Group recently said, "By 2005 only a few vendors will manufacture non-server-based products." Our open systems focus has allowed Digi to build and maintain long-term relationships with OEMs like Compaq, IBM and others, and operating systems vendors such as Microsoft, Novell and most recently, Red Hat. Value-added resellers (VARs) traditionally prefer open systems solutions -- when functionality is equal -- because it means they don't need trained experts on multiple proprietary technologies.

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Although networks are increasingly employing digital transmission technology, the majority still use analog phone lines. Our AccelePort products continue to be the leading choice for these users. DataFire products then provide an upgrade path to digital applications and round out a complete product portfolio to establish Digi as the leading vendor in this market. Standards-based systems are more readily networked. And networked systems allow the convergence of business applications.

Microsoft has played a pivotal role in driving the server-based market, by embedding advanced services into its Windows operating system. With the advent of Windows 2000, capability and robustness have advanced. This includes telephony services, and also vital technologies such as directory services. These developments enable converged applications between products of different vendors, and they permit smaller scale networks to enjoy the same capabilities previously only available to large networks.

[Our open systems focus has allowed Digi to build and maintain long-term relationships with OEMs.]

[Chart]

Year	Dollars
'98	338
'99	427
'00	532
'01	637
'02	750

Worldwide Server-Based
RAS Market, 1998-2000
(estimated end-user revenues
in millions)
source: International Data Corporation, 1998

Digi International has supported Windows networks from the very beginning, and this means that Digi products are installed in more Windows Routing and Remote Access Services (RRAS) installations worldwide than any other vendor. As these Windows systems take on new tasks, DataFire adapters are one of the most trusted and familiar brands among network installers.

[NEW MARKETS. With data and voice traffic converging at the network server, Digi will emerge as a premier provider of server-based computer telephony applications. To date, the computer telephony industry has been dominated by proprietary solutions. The combined calendar year 2000 RAS and computer telephony integration (CTI) markets represent an estimated \$1.2 billion opportunity, growing at 32 percent annually. The open systems RAS adapter market is estimated to reach \$750 million in 2002, while the market for multi-function, open systems CTI adapters, as measured by Frost and Sullivan, is expected to top \$2 billion by 2004.]

[PARTNERS. Digi is the only vendor providing both digital and analog products for remote access connectivity using RAS in Windows 2000. Users can quickly

configure Digi's products by clicking on the Digi icon in Windows' Add New Hardware Wizard, a new feature of Windows 2000. Digi's AccelePort products are the first products of their kind to be listed under the Wizard's Serial Port Device Class. "Communications, including remote access, is a critical, growing market that Windows NT addresses today very effectively, and this offering gets even more compelling for customers in Windows 2000, said Mark Lee, product manager of Windows Communications, Microsoft Corporation.]

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Small and medium-size businesses comprise more than 98 percent of all business enterprises in the world, and these organizations are rapidly installing networks. These customers do not, as a rule, have IT departments or large computing budgets. Therefore, they require solutions on a smaller scale -- though with many of the same functions as larger systems -- that they can begin using immediately. According to International Data Corporation, "By 2000, entry servers will grow to be larger than the combined mid-range and high-end server markets. It is essential for all global server vendors to have a strong commitment to this critical segment of the market."

[Digi's commitment is to provide the finest communications interface for leading standards-based server systems.]

Digi has served small and medium applications for almost 15 years -- so Digi's reputation for support and ease-of-use is firmly established. This is an enviable position against competitors who only understand the needs of very large networks. We fully intend to leverage this advantage and our experience.

One of the key new technologies is computer telephony integration (CTI) -- the merging of data and phone networks. CTI will drive sales of IT equipment to new heights, as the benefits of automating elements of customer service become apparent. Digi's advanced development in this field has achieved design wins with major technology partners and made us a viable player in telecommunications carrier markets as well as corporate computing environments.

The success of open-systems standards has affected competition in a variety of ways. Application developers can count on a consistent set of operating systems services, and concentrate on providing the most innovative solutions to business problems. This benefits users, because they can select from "best-of-breed" products in each product category, and it benefits

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Digi, since we can dedicate ourselves to providing functions to operating systems and applications instead of developing the applications ourselves. This focus on "core competency" allows Digi to maintain a market leadership position in remote access markets and expand that specialization expertise across a wide range of vertical markets.

[Digi products are installed in more RRAS installations worldwide than any other vendor.]

[Chart]

Year	Dollars
'99	94.2
'00	181.2
'01	344.6
'02	601.1
'03	1,043
'04	2,000

Server-Based CTI Adapter
U.S. Market Growth (estimated, in millions)
source: Frost and Sullivan

Digi recognizes -- and, in fact, it is the hallmark of open systems -- that customers will decide what is the best product for their particular needs. Digi's commitment to the market is to provide the finest communications interface for the leading standards-based server systems. This is possible because Digi can focus on interfacing with the most popular operating

environments, and supporting the communications services and protocols that enable converged applications.

For example, our adoption of digital signal processor (DSP) technology provides a highly versatile platform, allowing a single engineering group to program added value into multiple product lines. It also allows Digi to support the latest communication devices like 56K modems and the foundation to support the advanced UNIX operating environments like Sun Solaris, IBM AIX and HP/UX, as well as open source software like Linux.

Digi's emphasis on supplying best-of-breed solutions has aligned us with market drivers like Microsoft, Sun, Intel and Linux. Our products are the leading brand choice within our distribution channel, known for their quality, versatility and ease of integration. The result: Digi is well-positioned to dominate our niche in the growing open systems, server-based market.

[OPPORTUNITY. Digi's products currently sell strongest in small and medium enterprises (SMEs), and chiefly among analog multiuser and analog RAS applications. Due to the abundance and low cost of analog connections, digital connections for the emerging SMEs are still in the very early stages but represent a tremendous growth opportunity. In the United States alone, there are over 9.2 million SME organizations. One of the most significant markets for these products is Microsoft Windows NT and 2000, where Digi leads analog connections. This leadership, coupled with a new state-of-the-art product line, means there are few vendors as well-positioned as Digi to dominate the SME segment.]

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DIRECTORS AND OFFICERS

DIRECTORS

JOHN P. SCHINAS (3)

Mr. Schinas is a founder of the Company and has been its Chairman of the Board since July 1991. He has been a member of the Board of Directors since the Company's inception in July 1985 and served as the Company's CEO from July 1985 to January 1992 and interim CEO from February to October 1999.

JOSEPH T. DUNSMORE

Mr. Dunsmore has been a member of the Board of Directors and President and Chief Executive Officer of the Company since October 24, 1999. Mr. Dunsmore has more than 17 years' experience in the data communications and telecommunications industries and has held executive management positions in a number of companies including Paradyne, AT&T Paradyne, U.S. Robotics, 3Com and, most recently, Lucent Technologies, where he served as Vice President of Access in the Microelectronics Group.

WILLIS K. DRAKE (2)

Mr. Drake has been a member of the Board of Directors since 1987 and a private investor since 1983.

RICHARD E. EICHHORN (2)(3)

Mr. Eichhorn has been a member of the Board of Directors since 1987. Since April 1992, Mr. Eichhorn has been a private investor.

KENNETH E. MILLARD (2)

Mr. Millard has been a member of the Board of Directors since October 1999. He has been the President and COO of Telular Corp., a tele-communications company, since April 1996. Mr. Millard has held various executive management positions in the telecommunications industry and worked as an attorney for AT&T and Wisconsin Bell. Mr. Millard continues to serve as a director of Telular and also serves as a director of Omnitech, a private corporation.

ROBERT S. MOE (1)(2)

Mr. Moe has been a member of the Board of Directors since October 1996. From 1981 to his retirement in 1993, he was the Chief Financial Officer of Polaris Industries, a manufacturer of snowmobiles, all-terrain vehicles and personal watercraft.

MYKOLA MOROZ (1)

Mr. Moroz has been a member of the Board of Directors since July 1991. Mr. Moroz

was a founder of the Company and CEO from January 1992 to September 1994. Mr. Moroz was Chief Operating Officer of the Company from July 1991 to January 1992. From October 1985 to July 1991, he occupied various management positions with the Company. He is now a private consultant.

DAVID STANLEY (1)(3)

Mr. Stanley has been a member of the Board of Directors since 1990. Mr. Stanley is the retired Chairman and CEO of Payless Cashways, Inc., a building materials retailer.

- (1) Audit Committee
- (2) Compensation Committee
- (3) Corporate Governance and Nominating Committee

EXECUTIVE OFFICERS

JOSEPH T. DUNSMORE
President and Chief Executive Officer

DOUGLAS J. GLADER
Executive Vice President and Chief Operating Officer

SUBRAMANIAN KRISHNAN
Senior Vice President and Chief Financial Officer

CORPORATE SECRETARY

JAMES E. NICHOLSON
Partner, Faegre & Benson LLP

CORPORATE GOVERNANCE

The majority of the Board's membership is comprised of non-employee directors.

The compensation and audit committees are comprised of all non-employee directors.

The positions of Chairman of the Board and Chief Executive Officer are separate.

The Digi logo is a registered trademark of Digi International. All other brand names or product names used herein are trademarks or registered trademarks of their respective holders.

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STOCKHOLDER AND INVESTOR INFORMATION

STOCK LISTING The Company's Common Stock trades on the Nasdaq National Market tier of the Nasdaq Stock Market(TM) under the symbol "DGII." At December 10, 1999, the number of holders of the Company's Common Stock was approximately 8,028 consisting of 356 record holders and approximately 7,672 stockholders whose stock is held by a bank, broker or other nominee.

High and low sale prices for each quarter during the years ended September 30, 1999 and 1998, as reported on the Nasdaq Stock Market, were as follows:

STOCK PRICES

1999	FIRST	SECOND	THIRD	FOURTH
High	\$16.38	\$11.75	\$11.00	\$13.50
Low	\$ 8.56	\$ 6.25	\$ 6.25	\$ 9.88
1998	FIRST	SECOND	THIRD	FOURTH
High	\$22.75	\$28.62	\$29.50	\$28.25

Low \$13.75 \$17.00 \$19.50 \$ 9.62

DIVIDEND POLICY

The Company has never paid cash dividends on its Common Stock. The Board of Directors presently intends to retain all earnings for use in the Company's business and does not anticipate paying cash dividends in the foreseeable future.

The Company does not have a Dividend Reinvestment Plan or a Direct Stock Purchase Plan.

STOCKHOLDER INFORMATION

Transfer Agent and Registrar
Norwest Bank Minnesota, N.A.
Norwest Shareowners Services
P.O. Box 64864
St. Paul, MN 55164-0854
651-450-4004
800-468-9716

Legal Counsel

Faegre & Benson LLP
2700 Norwest Center
Minneapolis, MN 55402-3901

Independent Public Accountants

PricewaterhouseCoopers LLP
650 Third Avenue South
Minneapolis, MN 55402-4333

Annual Meeting

The Company's Annual Meeting of Stockholders will be held on Wednesday, January 26, 2000, at 3:30 p.m., at the Marquette Hotel, 710 Marquette Avenue, Minneapolis, Minnesota.

Investor Relations

A copy of the Company's Form 10-K, filed with the Securities and Exchange Commission, is available free upon request. Contact:

Investor Relations Administration

Digi International Inc.
11001 Brew Road East
Minnetonka, MN 55343
or call 612-912-DIGI
e-mail request to ir@diqi.com

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CORPORATE OFFICE

Digi International
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Minnetonka, MN 55343
TEL: 612-912-3444
FAX: 612-912-4991

NORTH AMERICAN SALES OFFICES

Digi International
11001 Brew Road East
Minnetonka, MN 55343
TEL: 800-344-4273, 612-912-3444
FAX: 612-912-4952

Digi International
1299 Orleans Drive
Sunnyvale, CA 94089
TEL: 800-466-4526
FAX: 408-744-0793

Digi International
Government Systems
10000 Falls Road, Suite 203
Potosi, MO 63854
TEL: 301-983-4699
FAX: 301-983-4542

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FAX: +49-201-97-47-111

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Surrey GU1 95AX
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FAX: +44-1276-753-674

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Digi International Australia Pty. Ltd.
Unit 10, 10 Gladstone Street
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Australia
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FAX: +31-20-5207-972

Digi International Denmark

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DK-3490 Risskov, Denmark
TEL: +45-49-17-70
FAX: +45-49-17-70-91

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13 06 Tower 13, 391A Orchard Road,
Ngee Ann City, Singapore 238837
TEL: +65-732-1308
FAX: 65-732-1312

Digi International (HK) Limited

Suite 1101-02, 11/F
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191 Java Road
North Point
Hong Kong
TEL: +852-2833-1008
FAX: +852-2572-6989

FAX: -61-2-9680-8178

DIGI INTERNATIONAL INC.
11001 Bren Road East
Minnetonka, MN 55343
TEL: 612-912-3444
FAX: 612-912-4991 (central fax)
nasdaq national market; DIGI
www address: www.digi.com
e-mail address: info@digi.com

SUBSIDIARIES OF THE COMPANY

Digi International Asia Pte Ltd

Digi International GmbH

Digi International FSC

Digi International (HK) Ltd.

Digi International Australia PTY Ltd.

Digi International Limited

Digi International SARL

TTK International, Inc.

CONSENT OF INDEPENDENT ACCOUNTANTS

We consent to the incorporation by reference in the Form S-8 registration statements of Digi International Inc. for its Stock Option Plan (File No. 33-32956, File No. 33-38898, File No. 333-99 and File No. 333-23857); for its Employee Stock Purchase Plan (File No. 333-1821); and for its Non-Officer Stock Option Plan (File No. 33-57869) of our report dated December 15, 1999, on our audits of the consolidated financial statements of Digi International Inc. as of September 30, 1999 and 1998, and for the years ended September 30, 1999, 1998 and 1997, which report is included in or incorporated by reference in this Annual Report on Form 10-K.

PricewaterhouseCoopers LLP

Minneapolis, Minnesota
December 27, 1999

Consent of Independent Auditors

We consent to the incorporation by reference in the Form S-8 Registration Statements (File No. 33-32956, File No. 33-38898, File No. 333-99 and File No. 333-23857) of Digi International Inc. for its Stock Option Plan; Form S-8 Registration Statement (File No. 333-1821) of Digi International Inc. for its Employee Stock Purchase Plan and Form S-8 Registration Statement (File No. 33-57869) of Digi International Inc. for its Non-Officer Stock Option Plan of our report dated October 28, 1997, with respect to the financial statements of AetherWorks Corporation for the years ended September 30, 1997 and 1996, and the period from February 24, 1993 (inception) to September 30, 1997, included in the Annual Report (Form 10-K) of Digi International Inc. for the fiscal year ended September 30, 1999 filed with the Securities and Exchange Commission.

/s/ Ernst & Young LLP

Minneapolis, Minnesota
December 28, 1999

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EXHIBIT 24

DIGI INTERNATIONAL INC.

Power of Attorney
of Director and/or Officer

The undersigned director and/or officer of Digi International Inc., a Delaware corporation, does hereby make, constitute and appoint Joseph T. Dunsmore and Subramanian Krishnan, and either of them, the undersigned's true and lawful attorneys-in-fact, with power of substitution, for the undersigned and in the undersigned's name, place and stead, to sign and affix the undersigned's name as such director and/or officer of said Corporation to an Annual Report on Form 10-K or other applicable form, and all amendments thereto, to be filed by said Corporation with the Securities and Exchange Commission, Washington, D.C., under the Securities Act of 1934, as amended, with all exhibits thereto and other supporting documents, with said Commission, granting unto said attorneys-in-fact, and either of them, full power and authority to do and perform any and all acts necessary or incidental to the performance and execution of the powers herein expressly granted.

IN WITNESS WHEREOF, the undersigned has hereunto set the undersigned's hand this 10th of December, 1999.

/s/ John P. Schinas

John P. Schinas

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DIGI INTERNATIONAL INC.

Power of Attorney
of Director and/or Officer

The undersigned director and/or officer of Digi International Inc., a Delaware corporation, does hereby make, constitute and appoint John P. Schinas, Joseph T. Dunsmore and Subramanian Krishnan, and any of them, the undersigned's true and lawful attorneys-in-fact, with power of substitution, for the undersigned and in the undersigned's name, place and stead, to sign and affix the undersigned's name as such director and/or officer of said Corporation to an Annual Report on Form 10-K or other applicable form, and all amendments thereto, to be filed by said Corporation with the Securities and Exchange Commission, Washington, D.C., under the Securities Act of 1934, as amended, with all exhibits thereto and other supporting documents, with said Commission, granting unto said attorneys-in-fact, and any of them, full power and authority to do and perform any and all acts necessary or incidental to the performance and execution of the powers herein expressly granted.

IN WITNESS WHEREOF, the undersigned has hereunto set the undersigned's hand this 10th of December, 1999.

/s/ Robert S. Moe

Robert S. Moe

3

DIGI INTERNATIONAL INC.

Power of Attorney
of Director and/or Officer

The undersigned director and/or officer of Digi International Inc., a Delaware corporation, does hereby make, constitute and appoint John P. Schinas, Joseph T. Dunsmore and Subramanian Krishnan, and any of them, the undersigned's true and lawful attorneys-in-fact, with power of substitution, for the undersigned and in the undersigned's name, place and stead, to sign and affix the undersigned's name as such director and/or officer of said Corporation to an Annual Report on Form 10-K or other applicable form, and all amendments thereto, to be filed by said Corporation with the Securities and Exchange Commission, Washington, D.C., under the Securities Act of 1934, as amended, with all exhibits thereto and other supporting documents, with said Commission, granting unto said attorneys-in-fact, and any of them, full power and authority to do and perform any and all acts necessary or incidental to the performance and execution of the powers herein expressly granted.

IN WITNESS WHEREOF, the undersigned has hereunto set the undersigned's hand this 10th of December, 1999.

/s/ Willis K. Drake

Willis K. Drake

4

DIGI INTERNATIONAL INC.

Power of Attorney
of Director and/or Officer

The undersigned director and/or officer of Digi International Inc., a Delaware corporation, does hereby make, constitute and appoint John P. Schinas, Joseph T. Dunsmore and Subramanian Krishnan, and any of them, the undersigned's true and lawful attorneys-in-fact, with power of substitution, for the undersigned and in the undersigned's name, place and stead, to sign and affix the undersigned's name as such director and/or officer of said Corporation to an Annual Report on Form 10-K or other applicable form, and all amendments thereto, to be filed by said Corporation with the Securities and Exchange Commission, Washington, D.C., under the Securities Act of 1934, as amended, with all exhibits thereto and other supporting documents, with said Commission, granting unto said attorneys-in-fact, and any of them, full power and authority to do and perform any and all acts necessary or incidental to the performance and execution of the powers herein expressly granted.

IN WITNESS WHEREOF, the undersigned has hereunto set the undersigned's hand this 10th of December, 1999.

/s/ David Stanley

David Stanley

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DIGI INTERNATIONAL INC.

Power of Attorney
of Director and/or Officer

The undersigned director and/or officer of Digi International Inc., a Delaware corporation, does hereby make, constitute and appoint John P. Schinas, Joseph T. Dunsmore and Subramanian Krishnan, and any of them, the undersigned's true and lawful attorneys-in-fact, with power of substitution, for the undersigned and in the undersigned's name, place and stead, to sign and affix the undersigned's name as such director and/or officer of said Corporation to an Annual Report on Form 10-K or other applicable form, and all amendments thereto, to be filed by said Corporation with the Securities and Exchange Commission, Washington, D.C., under the Securities Act of 1934, as amended, with all exhibits thereto and other supporting documents, with said Commission, granting unto said attorneys-in-fact, and any of them, full power and authority to do and perform any and all acts necessary or incidental to the performance and execution of the powers herein expressly granted.

IN WITNESS WHEREOF, the undersigned has hereunto set the undersigned's hand this 10th of December, 1999.

/s/ Richard E. Eichhorn

Richard E. Eichhorn

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DIGI INTERNATIONAL INC.

Power of Attorney
of Director and/or Officer

The undersigned director and/or officer of Digi International Inc., a Delaware corporation, does hereby make, constitute and appoint John P. Schinas, Joseph T. Dunsmore and Subramanian Krishnan, and any of them, the undersigned's true and lawful attorneys-in-fact, with power of substitution, for the undersigned and in the undersigned's name, place and stead, to sign and affix the undersigned's name as such director and/or officer of said Corporation to an Annual Report on Form 10-K or other applicable form, and all amendments thereto, to be filed by said Corporation with the Securities and Exchange Commission, Washington, D.C., under the Securities Act of 1934, as amended, with all exhibits thereto and other supporting documents, with said Commission, granting unto said attorneys-in-fact, and any of them, full power and authority to do and perform any and all acts necessary or incidental to the performance and execution of the powers herein expressly granted.

IN WITNESS WHEREOF, the undersigned has hereunto set the undersigned's hand this 10th of December, 1999.

/s/ Mykola Moroz

Mykola Moroz

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DIGI INTERNATIONAL INC.

Power of Attorney
of Director and/or Officer

The undersigned director and/or officer of Digi International Inc., a Delaware corporation, does hereby make, constitute and appoint John P. Schinas, Joseph T. Dunsmore and Subramanian Krishnan, and any of them, the undersigned's true and lawful attorneys-in-fact, with power of substitution, for the undersigned and in the undersigned's name, place and stead, to sign and affix the undersigned's name as such director and/or officer of said Corporation to an Annual Report on Form 10-K or other applicable form, and all amendments thereto, to be filed by said Corporation with the Securities and Exchange Commission, Washington, D.C., under the Securities Act of 1934, as amended, with all exhibits thereto and other supporting documents, with said Commission, granting unto said attorneys-in-fact, and any of them, full power and authority to do and perform any and all acts necessary or incidental to the performance and execution of the powers herein expressly granted.

IN WITNESS WHEREOF, the undersigned has hereunto set the undersigned's hand this 10th of December, 1999.

/s/ Kenneth Millard

Kenneth Millard

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DIGI INTERNATIONAL INC.

Power of Attorney
of Director and/or Officer

The undersigned director and/or officer of Digi International Inc., a Delaware corporation, does hereby make, constitute and appoint Joseph T. Dunsmore and Subramanian Krishnan, and either of them, the undersigned's true and lawful attorneys-in-fact, with power of substitution, for the undersigned and in the undersigned's name, place and stead, to sign and affix the undersigned's name as such director and/or officer of said Corporation to an Annual Report on Form 10-K or other applicable form, and all amendments thereto, to be filed by said Corporation with the Securities and Exchange Commission, Washington, D.C., under the Securities Act of 1934, as amended, with all exhibits thereto and other supporting documents, with said Commission, granting unto said attorneys-in-fact, and either of them, full power and authority to do and perform any and all acts necessary or incidental to the performance and execution of the powers herein expressly granted.

IN WITNESS WHEREOF, the undersigned has hereunto set the undersigned's

hand this 10th of December, 1999.

/s/ Joseph T. Dunsmore

Joseph T. Dunsmore

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Appendix 5

Attorneys Eyes Only Pursuant to Protective Order

Attorneys Eyes Only Pursuant to Protective Order

Appendix 6

Attorneys Eyes Only Pursuant to Protective Order

Attorneys Eyes Only Pursuant to Protective Order

Appendix 7

Attorneys Eyes Only Pursuant to Protective Order

Attorneys Eyes Only Pursuant to Protective Order

Howard Declaration Ex. 2(A)

(PLACEHOLDER)

UNREDACTED NATIVE VERSION OF DOCUMENT
TO BE FILED SEPARATELY UNDER SEAL PURSUANT TO LR 5.3(b)(3)(B)(iii)

Howard Declaration Ex. 2(B)

(PLACEHOLDER)

UNREDACTED NATIVE VERSION OF DOCUMENT
TO BE FILED SEPARATELY UNDER SEAL PURSUANT TO LR 5.3(b)(3)(B)(iii)

Howard Declaration Ex. 2(C)

(PLACEHOLDER)

UNREDACTED NATIVE VERSION OF DOCUMENT
TO BE FILED SEPARATELY UNDER SEAL PURSUANT TO LR 5.3(b)(3)(B)(iii)